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Volta's Teaching in Como and Pavia: Moments of Academic Life under All Flags

1. Introduction

To talk about Volta's teaching, it is helpful, indeed necessary, to give a short account of the main events of his long life, the family and academic environment in which he was trained and where he operated. It shows his singularity as a man, teacher and scientist in eighteenth and nineteenth-century scientific society, against the background of the society he lived in and the political events he was involved in (and overwhelmed by), under all flags, in the context of a tumultuously transforming Europe.

He was a descendant of an aristocratic Lombard family strongly connected with the clergy and was brought up in a narrow, conservative family and scholastic environment.[1] However, his mature years were spent in the restless though exciting atmosphere of that period between the renaissance of Lombardy induced by the Austrian Reformation and the triumphs and defeats of the army of Napoleon's Empire. He essentially operated in those last thirty extraordinary years of the century of the Enlightenment. These years witnessed deep political, cultural and social transformations which reached their height with the French Revolution, the birth of the new Europe and the new America, the affirmation of scientific revolution with the advent of the new physics and its mathematisation, of the new chemistry and in general of natural sciences, as well as the establishment of a technological revolution in workshops and in transportation.

[1] His father Filippo was in the Society of Jesus for eleven years, and then returned to secular life. He died when Alessandro was eight years old. So the youngest uncle, whose name was Alessandro, was entrusted with his education. The economic conditions of the family were not brilliant. The three paternal uncles were: the already mentioned Alessandro, a canon, Battista, a deacon, and Antonio, an archdeacon. His mother, Maddalena Inzaghi, the daughter of count Giuseppe, was very devout and pious. Two of his sisters did not marry (Marianna and Cecilia, Benedictine nuns). His three brothers were destined for the priesthood: Giuseppe became a Dominican, Giovanni a canon, Luigi an archdeacon. The last, and his charming sister Chiara, Lodovico Reina's wife, were particularly close to Alessandro.

He accomplished his primary studies inside his family.[2] At 13 he was sent to the school of the Society of Jesus to attend courses in humanity and rhetoric. At 16 he left that school and entered the seminary. The reason for this change has never been explained.

It was assumed in his family that he would become a priest in the Society of Jesus. He managed to escape probably because he did not feel the vocation; his uncle Alessandro then would have liked to make him start legal studies in order to make him "a good lawyer". His mother's strong, tough character influenced his formation very much. The friendship of Giulio Cesare Gattoni (1741-1809), a canon, was precious to him.[3]

Since childhood he had shown great interest in natural science and, once he had done his homework as a restless and rebellious pupil, he devoted the rest of his time to his scientific formation by studying, in particular, electrical phenomena.[4]

Before his 18th year, he had already read the works of Peter van Musschenbroek (1692-1761), Jean Antoine Nollet (1700-1770) and Giambattista Beccaria (1716-1781) and at 18 he expressed his ideas in some letters written to Nollet and Beccaria, proving both firm grounding in the subjects he discussed and a singular spirit of observation. However, the schools he had attended had not given him adequate preparation in mathematics and physics, subjects which were often considered by his religious teachers as diabolic and misleading. His didactic and scientific training was self-taught, without "any direction but that of his investigating talent".[5]

[2] It is said that he had a worrying first childhood because of such retarded mental development that they feared he would remain dumb. However, though slowly, he became fluent at the age of seven.

[3] Father Gerolamo Bonesi, Alessandro's teacher, was convinced that "this young boy had been ab eterno predestined for his Society" and did his best to attract him into the Society of Jesus. When Gattoni became convinced "that in Volta there was not even the slightest idea of vocation for the Society", he informed Bonesi who reacted badly telling Gattoni himself that Alessandro was "the most obscure soul existing in Hell" and predicted that "he would adopt the most iniquitous behaviour, giving himself up to idleness and vices, deeply dishonouring his family and native country. On the other hand, what could one have expected from someone who had already incurred the anathema of the patriarch Saint Ignatius?"!, in GATTONI (1926), pp. 494-5; also in *VE*, I, p. 3.

[4] His curiosity towards nature led him, at the age of 12, to risk drowning in an attempt to check the popular rumour that in Monteverde, a spring near Camnago (Como), there was a vein of gold.

[5] GATTONI (1926), p. 496; also in *VE*, I, p. 4. Volta exalted in verse the beauties of physics which were gradually revealed to him. At 19 he wrote about it in Latin. Even before that he had composed a poem (lost) in Latin of 800 lines dealing with the seasons and another poem (*VA*, pp. 119-35) of 492 fluent, solid hexameters dealing with gunpowder, explosive gold, ignis fatuus and other things, showing a great mastery in the double difficulty of the subject treated and the form in Latin. Even in these early works he showed a great spirit of observation. Later also he wrote poetry (to tell the truth, not so perfectly): sonnets written on various occasions (*VA*, pp. 142-5). From the poetic viewpoint he belonged to the eighteenth century, therefore he was extraneous to the first ferments of the Romantic Revolution. He wrote, among other things, a short poem (*VA*, pp. 146-52) on the occasion of the ascent of Mount Blanc (August 4, 1787) by Horace Benedict de Sassure

At the beginning, his scientific work was to be developed privately, for a long time far from public institutions, in particular, the university. From 1765 and for many years he made use of the laboratory Gattoni set up at home and generously made available to him.[6]

Volta was ambitiously looking to stand comparison with the European culture of his time and its greatest representatives in the scientific field, through direct contacts and exchanges with other schools. Paolo Frisi (1727-1784) Barnabite expert in educational problems helped him, putting him in touch with several Italian and foreign scholars.[7] In his scientific reports, though he knew Latin quite well, he

(1740-1799); some verses of his, freely translated from French by Volta himself (the original text in French has been lost), were appreciated by Giosuè Carducci.

[6] Gattoni, a versatile mind with a bent for scientific research as well as for religious and moral "preoccupations", set up in his house and with his own means, as early as 1765, when he was 24, a well equipped physics laboratory, a museum of natural history, a collection of artistic sculptures, a rich armoury, a remarkable library and a meteorological observatory. He dealt with problems concerning the properties of gases, electricity and meteorology; in 1768 he made a lightning-rod in his own house. One of his manuscripts, entitled *Giornale gallo-cisalpino scandaloso che contiene i fatti accaduti entro le mura della mia patria dal 1796 al 1801*, is an important source of information, though in its town and temporal limits. In particular, it is a source of information on Volta, his political attitudes, his character and his vision of religious and moral problems; the latter are the ones which animate the manuscript. However, not few reservations are required. In about 1765, Volta received full hospitality at Gattoni's house as well as the possibility of making use of the equipment and books Gattoni had been gradually collecting. Their friendship started when they were both very young. In spite of several serious clashes, due to the diversity of their characters and often to incomprehension about religious problems, it lasted in all their lives. Gattoni gives information about these clashes in his *Giornale*. They probably also derived from the different scientific fortunes of them both, negatively influencing Gattoni because both his very strong desire to make himself noticed and his sensible self-esteem were hurt. Nevertheless, Gattoni always praised Volta's scientific merits sincerely and fervidly, though he quite often complained that some of the things he had made, observed and analysed before Volta, were later claimed by Volta as his own (inflammable air, lightning-rod and others). Volta owed Gattoni a great deal, at least as far as the beginning of his scientific work is concerned. Nevertheless, in his writings he incomprehensibly never explicitly mentioned what Gattoni meant for him, not a word of gratitude, and Gattoni, sadly complained about it on more than one occasion. Nevertheless, according to Giambattista Giovio, writer and biographer, exponent of the culture of Como, "it was almost in Gattoni's rooms that Volta acquired most of his European name". Volta quoted Gattoni on few occasions, almost always without uttering his name and with a vague reference to a "friend" from Como; remembering the "condenser" (1782), speaking of an instrument employed by him, he added in a footnote and in brackets "placed in the house of a friend of mine, an amateur physicist, the canon Mr. Gattoni from Como", in VOLTA (1816), I, p. 241.

[7] Paolo Frisi, astronomer, mathematician, physicist and applicative-technician as well, was a European representative of post-Newtonian philosophy. He came from the "Sapienza" of Pisa and had dealt with dynamics, physics astronomy, mathematics, geodetics, hydrodynamics and electricity. He played a great part in the rationalization of the course of rivers and canals in Lombardy at the request of Emperor Joseph II and the Chancellor of the Habsburg Empire Anton Kaunitz-Rietberg von Wenzel, who had seen in him a highly scientific technician as well as a

mainly employed – except in his earliest works – Italian and French. His writings were often in the form of "epistolary memoirs".

In 1774, thanks to the interest of Carlo Firmian (1718-1782), the plenipotentiary minister for Lombardy, he started teaching as superintendent of the public schools of Como. It was his first public position and, to tell the truth, quite a modest one if we consider that even then he had achieved remarkable fame in the scientific world.[8]

In 1775 he was appointed permanent teacher of Experimental Physics in the Ginnasio (grammar school) of Como.

In 1777, thanks to Firmian's and Kaunitz's approval and help, he made the first of his scientific journeys to Switzerland, Alsace and Savoy.[9]

The following year he was called by the University of Pavia to hold the chair of "Particular and Experimental Physics". The fame he had by then placed him among that group of outstanding personalities of high reputation which the Government of Vienna had wanted in that chair within the project of reformation and re-launching of that University.

In 1781 and 1782 he travelled for scientific purposes into Europe: Savoy, Switzerland, Germany, Belgium, Holland, France and England. In 1784, encouraged by Kaunitz, he travelled to Germany and Austria always with the purpose of tracking down new instruments and approaching scientists in those States.

In 1785 he was appointed Rector of Pavia University.

In 1794, by then 50 years old, he married Donna Maria Alonsa Peregrini. They had three children: Zanino, Flaminio and Luigi; Flaminio, the most gifted and promising, died when he was only 18 years old.

Still very young, he operated in European dimensions and his fame as an exceptional experimenter was soon solidly established among all the most famous scientists even

teacher of technicians useful in various sectors of civil life. He contributed to important newspapers and had great faith in exact science and in the pedagogic effectiveness of scientific reason. He harshly opposed the pedagogic methods and ways of practising science used by the Jesuit Fathers.

[8] Carlo Firmian was educated at Trento, Innsbruck, Salzburg, Leyden and Paris. In Salzburg he ran an academy in his own house. After having acquired the friendship of the Chancellor Anton Kaunitz, he was sent to Naples as plenipotentiary minister, then to Rome as ambassador and finally to Milan where he stayed for twenty-three years. He was a patron rather than a politician, he had liberal views and was moderately Jansenist. He was very skilful in choosing men of merit and created in Lombardy an atmosphere of freedom of speech and writing, achieving innovations and reforms of fundamental importance for cultural and economical growth. He left his library of 40,000 volumes to the town of Milan.

[9] In those days, Italians travelled very little – even less abroad – provincially avoiding comparison with other cultures. Indeed Volta, differently from his fellow-countrymen and from many colleagues, looked for comparison with others, without restraint or complexes. He made seven most important "literary trips" which led him to know Europe better than Italy because in the former he found fine interlocutors and for scientific and didactic problems in the latter a kind of cultural-scientific semi-desert.

before the invention of the battery. He became their friend and collaborator, discussing with them with self-assurance, respect and admiration, as an equal. He was accepted as a member in all the main Academies and scientific Societies.

He was extremely self-confident. This resulted from his inner qualities, but was probably due also to the fact that he was a strong, handsome man, vital and active. Though the great calm of his writings would suggest the opposite, he was endowed with a lively mind, great exuberance and an enterprising spirit. As a scientist, he felt the need to tell other people what he thought, openly and without reserve, and listen to what they thought.

He was described by everybody as "a charming man, with pleasant, interesting and jovial conversation".[10]

His self-confidence was set off by a great sense of measure and balanced by a wealth of virtues, above all modesty.[11]

He had generous and powerful benefactors, such as Emperor Joseph II, Carlo Firmian and Anton Kaunitz under Austrian rule, and Napoleon under French rule, and he always showed deep gratitude to them. He was lucky because, together with

[10] He had an affair with the singer Marianna Paris whom he would have married if his family had not disagreed; and it certainly was not the only affair he had with women. In his Parisian stays he very rapidly succeeded in establishing friendly relationships with the greatest French scientists of his time and in getting into the good graces of some brilliant ladies of that city, such as Madame le Noir de Nanteuil; he was "often there at dinner" and spent "soirées à écrire" avec madame "who studied physics with passion" (*VO*, I, p. 12 and *VE*, II, p. 100). "Dans l'intimité méme, Volta avait la plus vive répugnance pour toute conversation relative aux affaires publiques; il ne se faisait aucun scrupule d'y couper court, dès qu'il en trouvait l'occasion, par un de ses jeux de mots qu'en Italie on appelle *freddure*, et en France calembour. il faut croire qu'à cet égard une longue habitude ne rende pas infaillible, car plusieurs des *freddure* du grand physicien, qu'on n'a pas dédaigné de citer, sont loin d'etre aussi irréprochables que ses expériences", in ARAGO (1854), p. 235.

[11] Studies and experimentation had not distracted him from the problems of his land. In his letters, his interest in the economy of the Como area appears here and there. His participation in the sittings of the town Council was very attentive and sometimes he intervened in the discussions on budgets and competitive prices with insight and competence. The important, first attempts at worker's organisations were born in the north of Milan and, in particular, in the Como area. The mercantile system, encouraged by the Government of Vienna, affirmed itself. That "enterprise culture" and, at the same time, that "working culture" which was later to determine Lombardy's industrial fortunes, were developing. The wool industry was replaced by the silk industry, revived, after the dark centuries of Spanish domination, under Maria Theresa who opened the markets of Austria and Germany with particular tax exemptions and special customs duties. Volta dealt with silk problems several times and on the most varied occasions, both from the scientific viewpoint and from the technical one. They were the basis for an important source of work and then of life for his fellow-citizens. He also dealt with the spread of potato-growing in Lombardy, of the spinning of lupine and asbestos and of other things. The inhabitants of Como associated the name of Volta with silk on more than one occasion. In 1899 wishing to honour him in the first centenary of the invention of the pile, they added to the electrical exhibition organized on that occasion a silk exhibition which was not less important. A fire destroyed the exhibition and many of Volta's relics. Those which are authentic and now preserved in Como, Pavia or elsewhere are very few.

a few others, he found in those princes that enlightened and innovating spirit which allowed him to express, without particular influences, his peculiar creative abilities and to live in that extraordinary atmosphere of his time in which scientific thought freely and clearly circulated all over the world. However, his attitude towards the political events of the time has never been clear; in many respects and for many people, it was judged ambiguous, since it was opportunistic. He had been an Austrian subject for 51 years, then citizen of the Cisalpine Republic and Napoleon's Kingdom for 18 years, and finally an Austrian subject again for 13 years. He was a careful, faithful and respectful subject or citizen, under all flags.

Volta was essentially pro Austria and conservative; he remained such, though with great "carefulness" even during French rule. He looked for advantages under all dominations, with a singular sense of reality and practical sense, always influenced by his willingness to take advantage of any opportunities for his good, that of his family and his country which, in his vision, did not go much beyond the borders of his dear Como.

Any conversation concerning public affairs saw him hesitating if not hostile. In 1796 he stated that "... he had always been extraneous to political and economic matters, also for a natural anti-genius". For him politics was a "stormy sea" from which it was advisable to keep oneself away.

Probably his political disengagement – or opportunism – must be attributed to many independent factors. Although to a certain extent this attitude was dependent on the vision and consideration of political commitment in the society he belonged to, on the peculiar character of his activity which was essentially scientific and finally on his temperament and education.

One of these factors was the fatalism and resignation of Lombard society of that time, society which had for too long been mortified by foreign domination, heir to centuries of slavery and innate Catholic pessimism, inclined to compromise, to manage to have it both ways; a society which had accumulated in its character so much ambivalence as to think that one thing and its opposite could co-exist or even coincide.

About two centuries of Spanish domination had suppressed any innovating thrust as well as any aspiration or dream of freedom and independence, creating an atmosphere of acquiescence to the foreigner, whoever he was. Then, under the first Austrian domination – at least as regards the first period which partly covered Volta's youth and which had in any case fully conditioned his forebears – externally Lombard society did not change noticeably, even though the early thinking of the Enlightenment started to have its effect, especially in the area of Milan. In fact, while Napoleon's Italian campaign may have been necessary, the revolution in ideas awakened and spread feelings of freedom, democracy and independence which had been quiet till then. Volta was gradually suffering the charms and repercussions created within himself by new emotions, apprehensions of uncertainties due to the upsetting of the established order which such ideas and feelings arouse.

Another factor was his natural talent – which became a life-long habit – for meticulous observation of natural phenomena, for serious meditation directed by

logic and critical spirit, and for the irreducibility in the need for objective proof which only rigorous experimentation can give. Volta fully summed up in himself all these characteristics. So we can understand his reluctance to let himself follow passion and political exaltation with all the irrationalities they often involve. His reserve as regards public political manifestations certainly corresponds to the truth in so far as it is witnessed. Nevertheless, in private meetings, in restricted circles of sure friendship there is witness to the fact that he, overcoming his hesitations, spoke about and discussed political problems with a certain interest. However his family was not in a healthy financial state and, since he was very careful about protecting his own interests, this could only have strong repercussions on his prudent behaviour not to expose himself to political adventures which would have upset his life, the life of his family and of his native country.

A further factor must be looked for in his temperament, which led him to consider and admire people for their intrinsic and personal value rather than for their political thought and political power. He had strongly felt the charm of the princes he had met, both Austrian and French. Such an inclination after all was consistent with his continuous desire, as an academic, to get in touch and confront himself with the most distinguished personalities of the scientific world of his time; even from the age of only 20!

During the exciting years of the French occupation, (May 1796) as citizen of the new Cisalpine Republic he did not hide his own gratefulness towards Vienna, by which he had been well-favoured. Volta's initial coldness towards the French and his distrust towards his Jacobin colleagues certainly contributed to the measure which would take him away from Pavia for some months.

His gradual and careful approach to new ideas did not create serious difficulties when the Austrians, three years later (1799) came back and closed the University.

The winners, in spite of the appellative of "semi-Jacobin" or even "Jacobin", deprived him of his work but not of his freedom, as in the case of Carlo Barletti (1735-1800), a physicist and colleague in Pavia and of others who welcomed the French openly and happily; he simply lost the chair and salary. The following year, when the French came back, he was reinstated, in spite of the appellative of "Austrian sympathiser", by Napoleon in person. He was openly a great admirer of Napoleon and then manifested to the neo-Emperor of France and King of Italy, "boundless subjection and fidelity"!

In 1794 he received from the "Royal Society", of which he had been member since 1791, the Copley gold medal in recognition of his scientific merit.

In 1801 he went (together with the colleague of general chemistry Luigi Valentino Brugnatelli (1761-1818)) to Paris and illustrated to the *Classe des Sciences* of the *Institut de France* his researches and in particular those which led to the invention of the pile. Napoleon, first Consul, took part in three meetings of the Class. He had great success but his natural modesty was not upset.

In the same year, together with Brugnatelli, he was appointed member of the Council of Lyons (or "Council of Cisalpines") and he attended the meetings of the following January. Napoleon needed votes to be elected President of the Cisalpine Republic.

On Napoleon's suggestion he was given a golden medal, later he was appointed Chevalier of the Legion of Honour (1805), Chevalier of the Italian Royal Order of the Iron Crown (1806), Senator (1809) and then Count (1810) of the Italian Kingdom. Previously Napoleon had granted him a yearly pension from the property of the Bishop of Adria (1805).[12]

When Napoleon fell, he was involved in Milan in a popular tumult and he hardly succeeded in escaping the violence of insurgent pro-Austrians (1814), but there are different versions of this episode.

The Austrian restoration did not cause him serious difficulties; the Government of Vienna called him back to Pavia as director of philosophical studies of that University.

He was the expression of eighteenth-century society and culture and the upset of those days could not but touch him deeply; he gradually withdrew from the scene and definitively five years later (1819).

After a brief illness, he died in Como on March 5, 1827, 82 years old.

He was at peace with his faith, as he had been, apart from some youthful "deviations", during all his long life. The family and school education he had received could not produce different effects; the evidence is reliable. He died comforted by Holy Communion.

Although he had stated in his declaration of faith that he had "always followed, both inwardly and outwardly, Roman Apostolic Catholic Religion", he nevertheless confessed "to being guilty of many faults and disorders", so that he was suspected of "some disbelief".[13]

[12] From the meetings at Lyons till the fall of the Italian Kingdom, he was entrusted with different offices of public utility: President of the general Council of the Lario Department, President of the Water Magistracy, Proof-reader and member of the central office of the Freedom of the Press, President of the Constituency of the Lario Department.

[13] During his youth, influenced by then popular materialistic thought, he more than once called in question, and was going to judge, belief in God as fallacious. However, no writing by Volta confirms that; instead, a certain aversion for monastic orders appears here and there and, in particular, some distrust towards the Society of Jesus. Also during his early maturity he was inclined to "aberrations", though different from those of his youth. As a friend and follower of the theologian Pietro Tamburini (1747-1827) he soon embraced his thought and settled to the left of the Catholic movement, without hiding his Jansenistic inclinations. No doubt he was also influenced by his contacts with scientists and humanists from beyond the Alps in whom he often found hostile and more or less open attitudes towards Roman Catholicism, as well as by the relationships with his colleagues from Pavia University, among most of whom he detected an unprejudiced vision of religious problems supported by a genuine secular spirit. However the extent of his sympathy for and interest in the Jansenist movement is not clear; in his letters and works he makes virtually no mention of it.

2. Volta's Teaching in Como and Pavia

The general outline of educational, scientific and technological thought of post-Renaissance Europe has been illustrated elsewhere. This thinking was to explode clamorously in the one hundred years of scientific and technological revolution (about 1750-1850). We have then tried to introduce, the particular Italian and Lombard picture into the general one, underlining the deep differences and delays as regards what was slowly taking shape and becoming established in the most advanced States of central-northern Europe. These differences and delays were essentially attributable to widespread cultural-scientific poverty due to inertia, if not hostility, towards the penetration of new ideas by a ruling class addicted to the "colonial" state brought by foreign rules and inclined to uncritical observance of the Church's precepts.

The reforms promoted by Maria Theresa Hapsburg-Lorraine, and extended by her son Joseph II in the second part of the seventeenth century, infected all the structures of the Empire and, in particular, the educational system.

The reforming spirit coming from Vienna was to change radically the educational, scientific and technological picture of Lombardy, though with remarkable slowness. The introduction of new regulations inspired by moderate liberality was to produce similar effects in Tuscany.

In both cases the roots of such a spirit must be looked for in the cultural tradition of the Hapsburg-Lorraine family.

In this section we will mention some moments of Volta,s teaching in Como and in Pavia and some events he was involved in as a teacher at Pavia University.

2.1. Volta's Teaching in Como

At the beginning of the period of Austrian reforms, Volta was working privately in the quietness of his native town. It is amazing that the Government of Vienna took so long to consider exploiting his qualities as an open-minded, resourceful scientist which had already led him to wide international fame.

Firmian's suggestion of Volta for the modest appointment as deputy of public schools in Como (1774) underestimated his abilities and mortified him.

Nevertheless, he willingly accepted the task and applied himself to it with enthusiasm, glad to contribute to the "progress of the sciences" and to "the happiest culture of the entire state and, in particular, of my country, in whose service I now like to see myself engaged, and I wish and desire to do my best in order to make my effort fruitful".[14] He certainly did not sacrifice his researches which meanwhile led him, among other things, to the invention of the "perpetual electrophorus" (1775).

[14] *VE*, I, p. 72.

> In undertaking his appointment, he found an alarming situation due to neglect and disorganization. More than one year before, the Society of Jesus, which till then had had an important role in Lombard educational structures, had been abolished. However, at least at the beginning, he did not take particular initiatives pending instructions on the reforms to be adopted, which, anyway, were soon to come.

Firmian, a faithful and careful interpreter of Vienna's reforming spirit, proposed a radical reorganisation of studies, starting from all the grammar schools of Lombardy. In 1775, Volta sent Firmian, "In the fulfilment ... of the precious commands of Your Excellency", a long and interesting report entitled *Sul modo di insegnare*[15] which summed up his ideas on the reform of the educational system of the low and high classes of Como's schools. The reality he had found was that inherited from Jesuit schools and his ideas were definitely innovatory, if not revolutionary, compared with the past.

The report is full of observations on several subjects.

He substantially proposed "a wide education but entirely oriented towards the present". Lacking the will to go back to its origins, the original Latin and especially Greek texts, he replaced, for example Homer's works, by the "best passages taken from some fairly good translations" if not even from some "ready summaries, to which the master can easily refer". As for Latin, one must never forget that "students, after having finished their courses, will pay more attention to and will get more advantage from French than from Latin, not to mention those who study exclusively for the missal. On the other hand, all those who had been already in schools and spent their studies according to the old practice, after some years, all that they remember about Latin is but the years they badly spent and lost in studying it. If they had learnt enough French to understand a book, cultivating, for their personal taste, the reading of one or other French work, would they choose to train themselves in some part of the letters or sciences?"

What is stressed is the necessity of giving suitable space to the teaching of mathematics and natural sciences because Volta was convinced that "to know some arithmetic was much more useful than to know Latin" and that "the importance of knowing some arithmetic extends from the lord, the citizen, the merchant to the shopkeeper, the pioneer, the peasant"; the teaching of the "Tuscan" Italian language had to be primary, attaching less importance to Latin themes "bristling with difficulties and obstacles". The teaching of foreign languages had to be particularly looked after.

The general reorganization of Lombard grammar schools, particularly following these lines, was for Volta the heart of his reforming plan.[16]

However, we are not going to mention the particular here, because his ideas were not applied in consequence of a change of programs by the Government and with his transfer to the University of Pavia (1778).

[15] *VE*, I, pp. 440-69.
[16] VENTURI (1987), pp. 727-8.

The following year Firmian, spurred by Volta himself, appointed him professor of Experimental Physics in Como's public schools ("dispensed from the exam and with full salary"). However, he did not have books at his disposal because the library inherited by the Jesuits, "though rich", lacked the fundamental works of mathematics, physics and natural history; nor did he have a laboratory endowed with suitable instruments or a physics laboratory; he did not have at his disposal qualified members of the staff such as artisans or workmen.

As for scientific books, he sensibly provided them himself, filling the most serious gaps he had found.

In 1777 he violently clashed with Paolo Gamba (1753-?), a humanities teacher, over a conflict of competence. It was his first clash with a colleague. Firmian, however, diplomatically, did not side with either of them.

Volta diligently informed Firmian about all his initiatives and the results of his work. Complaints, however, were continuous and Firmian absorbed them patiently and then, as far as it was possible, acted.[17]

He was not successful because of objective difficulties, independent of Firmian's will, but he managed anyway to have financial and instrumental means.

Also spurred by him, Firmian meanwhile was pondering to reduce, at least to a certain extent, his plan for the development of grammar schools and local chairs and to concentrate the main efforts on the development of scientific teaching in the University of Pavia, which, according to Kaunitz, was to become "the central school of the State" (1779), keeping Göttingen as its inspiring model.

Volta's presence in the educational system of Como was very short (a few years) leaving little trace of his teaching. His presence in the educational system of Pavia, on the other hand, was to be very long (over thirty years) leaving many, precious traces.

For these reasons it is now important to open a long parenthesis on Austrian and French reforms of the educational system in Lombardy and, in particular, of the University of Pavia in which Volta was fully immersed.

2.2. Austrian and French Reforms of the University of Pavia

The First Austrian Rule and Related Reforms

At the beginning of the Austrian reform (about 1765), the standards of the University were very low.

[17] In 1778 Volta wrote to him thanking him for the help he had received and added, as an example, that he needed: "... an artificer here in Como, not only to repair the machines which with time and use break down, to make screw, replace pistons, work lenses, make brass keys, stretch and lathe plates etc., but to be also able in my turn to have someone build and work the things I may gradually invent and improve. I have already planned many, which, because of the lack of a skilful artificer (in Como there is no-one to work a brass, ivory, or wooden screw, to grind lenses to make cases; there is no cabinet-maker) remain unrealised" (*VE*, I, pp. 232-3).

The splendours of the Visconti-Sforza *Studium Generale* were very far behind. Centuries of ominous foreign rule and, consequently, widespread poverty and illiteracy, an almost total lack of scientific culture, provincialism and marginalization, had stifled the university's vigour and prestige. It was almost deserted and its present life did not keep any slight trace of the past splendour when, crowded with students and famous for distinguished teachers, it had steadily contributed to the progress and spread of culture.

Lecturers were often mediocre, humiliated in formal demonstrations, badly paid and more inclined to private teaching. There were very few students – about one hundred – and they were more desirous of academic qualifications, which had become "awards of ignorance and venality" (Kaunitz 1767), rather than of knowledge. Financial means were very poor. The equipment of laboratories and libraries was almost non-existent and when it did exist it was old and out of date. Didactic methods were old-fashioned and purely academic. Discipline and self-discipline had disappeared and become completely relaxed.

Scientific production was occasional and questionable.[18]

[18] With the coming of Spanish rule (1535) and the transfer of the Milan Dukedom to the direct dependence of the Spanish crown, the Senate of Milan inherited the ducal university: in fact, the care of the *Studium* of Pavia fell within the competence that the provincial law *Constitutiones Dominii Mediolanensis*, promulgated by the Emperor Charles V in 1541, ascribed to the highest Lombard magistrature. Its medieval structure (the University was founded in 1361) was kept according to the Senate's declared policy in favour of tradition and preservation. However, the organisational methods would modify themselves with the fading of such a near and culturally active ducal court as that of the Sforza's, firmly detaching themselves from the original model. The *Studium* certainly acquired organisational and cultural independence but it suffered from the lack of external stimuli the Senate was not able to offer. The Senate's promotional initiatives in favour of the *Studium* – except those about building – were few and far between, and in any case basically preserved the status quo by full observance of the dispositions from Madrid. In the about two centuries of Spanish rule, apart from the lack of political will and Madrid's intellectual inertia about which the Senate, because of its intrinsic weakness, could do very little, the most serious obstacle to any initiative was the lack of finance. The negative, and fatal, solution for the prestige of the *Studium* was adopted: reduction of the teaching staff and restriction of payments. Such a policy marked the whole seventeenth century with serious consequences on relationships between teachers and the authorities since they were involved in everlasting contention; but, above all, it led to giving up inviting external or foreign teachers. To remedy this situation and reduce retributive inequalities, the measures of fiscal immunity (and other similar ones) in favour of teachers were not very useful. The Senate always kept its discretionary power to appoint and confirm lecturers, as well as its control over salaries and fiscal immunities. This was essentially the only scholastic policy realistically applied by the Senate of Milan in the Spanish period. The provincialisation of the academic body, the hierarchical separation of chairs into "superior" and "inferior", inequalities in salaries and allowances even within this hierarchy, delays in the distribution of salaries and allowances, decrease in the numbers of well-known teachers and the ensuing general lowering of teaching standards, together with the Senate's tenacity in rejecting, in the name of its own jurisdictional autonomy, any measure elsewhere proposed, contributed largely to the very serious crisis of the *Studium* and, as a direct consequence, affected student recruitment.

The University, the only one in Lombardy till a few decades ago, reached a historic low, as regards scientific production and student attendance, in 1750. The financial endowment was still that established by Francesco Sforza (in 1447) and amounted to 44,000 Italian liras – a miserable amount.

Likewise deplorable was the state of the other Italian Universities. However, there were, at least in Naples, Padua and Turin, lively reform movements.[19]

However the Senate was jealous of the untouchable nature of the *Studium*, a quality which often appeared as one of the untouchable cornerstones of the autonomy of the Senate itself. At the beginning of the disastrous Spanish rule, more than 500 students populated the *Studium*; in less than a century this number was reduced to no more than 70. Nevertheless, such data are incomplete and uncertain and only from 1766, on the occasions of the preliminary works for the new plan of Austrian reformation, was information more precise. Anyway, it seems that during Spanish rule and the first Austrian domination the number of students was stationary at about one hundred or a little more between the two "portici" (courtyards) of the University. However, at that time, the depopulation of Italian Universities was general and that of Pavia does not seem to have been an exception. The creation of national *Studia* everywhere put geographical limits on recruitment, reducing the flow of students coming from any part of Europe. Protectionist measures applied almost everywhere had sacrificed the universal tradition of the *Studium*, preventing the young from going abroad, thus breaking up student communities which were once made up of students of different origins and nationalities. This was a very important factor in medieval cultural life. A further mark of such a situation, which can be traced back to the middle of the sixteenth century, lay in the great decrease in the production of books by local printing houses which, after a period of intense and fruitful collaboration with the *Studium*, would turn to different, new and certainly more profitable sectors.

[19] A document of 1767 (Milan State Archive, Studies fund) stated: "In those towns (e.g. Pavia) the schools of Barnabites, and the bishop's seminary are crowded and especially so are those of the Jesuits which, being in front of the University, attracted the students' attendance at the time; public schools were almost abandoned and deserted". Francesco Sartirana (councillor) in the same year wrote to Firmian: "Some boarders instead of coming to the University, attend the schools inside colleges or convents of regular orders"; Firmian himself observed that "Professors' in-house lectures" would be "more profitable to the students than public school teachers' ones". This does not mean that superior culture, historically fostered by university institutions, was weak or neglected in Pavia as in the rest of Lombardy. Though documentation on the reality of the studies in the period before Austrian reformation is very poor, it is ascertained that the circulation of knowledge among teachers, students and experts actually took place but, as already underlined, in various forms, official and unofficial, confused and scattered, and very often outside the university which, among other things, was no longer the only institution conferring qualifications. Besides universities, other public, semi-public or even private schools guaranteed the content of studies, at least within certain limits and in decadent forms: teachers' houses, academies, religious orders, patrician sitting rooms. However, even in such a disjointed, confused state as to roles, duties and objectives, the higher education system was still capable of meaningful cultural impulses. In 1766, in the age of Austrian reformation, the student population amounted to 153 students registered for the two "portici", among whom 71 were collegians (Quattro Marie, Griffi, Ghislieri, Castiglioni, Caccia, Borromeo); of the remaining 82, 50 were from Pavia, 32 were subsidised in different ways and 7 of these latter were Grigioni. The students who did not come from Pavia numbered 20. There were very few foreign students (Grigioni, Swiss, Tyrolese, of the Veneto region, Emilian, Ligurian), whereas the ratio between college students and the total was particularly favourable.

In this situation the first reform projects and then the final Austrian reform were started. The first project was suggested about 1760 by Frisi, probably at Firmian's request, in the sixties and is entitled *Piano per la Regolazione degli Studi della Università di Pavia e delle Scuole Palatine di Milano*.[20]

Frisi informed his plan according to a vision respectful of traditional liberality which if it could be accepted by Firmian, certainly could not be accepted by Vienna whose fundamental presuppositions were order, rationality and above all control, and therefore in contrast with that liberality which had always characterized the traditional way of acting of a university institution.

The Vienna behaviour soon appeared as a clear attack on the fundamental law on which the authority of the Senate was based in the scholastic field, that is the law *Constitutiones Dominii Mediolanensis* (see footnote 18). It meant the abandonment of well-established traditions which traced their origins back to 1541, the year said law was promulgated, an open denunciation of the true or presumed inefficiencies of the Senate in the scholastic field and finally, consistent with other initiatives, the clear will to increase central power to the detriment of local liberties.[21]

Therefore and finally, after prolonged uncertainties and fears, 1765 marked on the one hand a break with the past and on the other hand the opening of new perspectives for the whole Lombard educational system.

The "deputation" (mentioned in the notes) was formed by "homines novi" Gianrinaldo Carli, Giuseppe Cicognini, Michele Daverio, Niccolò Pecci, Giuseppe Pecis.

At the conclusion of the works of the deputation, Maria Theresa ordered the *Piano di Direzione, Disciplina ed Economia dell'Università di Pavia*[22] (1771) to be carried out, followed by the appropriate *Piano Scientifico* (1773) which had to serve the teachers "as an escort and direction to guide public science education, to make it more advantageous to the young".

If the elaboration of the reform from the first manifestations of intent to its final launching had covered many years, the effects of the reform were to be immediate and meaningful, proving the prudence employed in the discussion of a delicate subject, in a politically delicate moment in the relationships between Church and State.

The underlying spirit of enlightenment is as evident as its absolutist intention. The winner was the State and as such it could be accepted or not according to the ideological picture in which the reform was placed. From a strictly lay point of view,

[20] *Scritti inediti di Paolo Frisi*, Biblioteca del Politecnico di Milano, fasc. 34-35.

[21] "Because experience has unfortunately proved – the royal despatch of November 24, 1765 dictated – that the law of the New Constitution, which supported this task [that is university management] to the Senate, burdened with many other serious, daily occupations, was the worm which ate away the flower of good ancient Milanese literature. Therefore it was advisable to leave the province of studies, from Pavia University, the Palatine Schools of Milan and all the other schools of the town and of the State [...] to the Government which will make use of a deputation".

[22] Hereafter abbreviated as *Piano di Direzione.*

largely intolerant of the ties which had historically connected the educational structures of any level with the management of religious Orders – and so under the control of the Church – the State was certainly the expected winner; even more so if we think that the financial means to develop the renewed State University were drawn from the suppression of the other competing schools, both lay and religious. Some doubt can remain on the effectiveness of the abolition of competition and on the advantages of state monopolisation. In fact, the consequences of the reform were extraordinarily efficacious.

Actually, the *Piano di Direzione*, which dictated the norms for the functioning of the University, was strict both in its general aspects and in the minute details of everyday life. It left little room for initiative, and the order it established was rigorous both for teachers and students.

The *Piano Scientifico*, on the contrary and luckily, was pliable and open, leaving wide margins for individual initiative and creativity.

The officers of the University were responsible to the general Magistrate of Studies.

The Rector was a professor taken in turn from one of the four Faculties (Philosophy, Law, Medicine, Theology). He was elected by students and had to "behave according to the instructions established by the general Magistrate of Studies". He checked on the lecturers' punctuality, the students' behaviour and diligence, and reported on these matters to the Magistrate.

There was a Dean at the head of each Faculty. The assembly of Deans was called the Consistory, presided over by the Rector.

The University gained administrative autonomy and suitable financial means for its functioning and development. The buildings underwent huge, organic development under Giuseppe Piermarini's direction and with Leopoldo Pollack's collaboration.[23]

Even before the approval of the *Piano di Direzione*, Firmian suggested to Vienna calling to Pavia some exponents of scientific culture (particularly in Natural Science and Medicine) of that time, among whom there were the following: Ruggero Giuseppe Boscovich (1711-1787) for mathematics (1763), Pietro Moscati (1739-1824) for anatomy, surgery and obstetrical art (1763), Gregorio Fontana (1735-1802) for logic and metaphysics (1764) and then for mathematics (1768), Lazzaro Spallanzani for natural history (1769), Martino Natali (?-1791) for dogmatic

[23] Some of the most significant works realised were the following: the Physics Theatre (now Aula Volta), the Anatomy Theatre (now Aula Scarpa), the Leano building – which borders the University through the so-called "Street of Chains" – was restored and added to the ancient body of the two courtyards and with remarkable reconstruction and innovations shaped the final aspect of the University building. The frieze in Strada Nuova was completed later, in 1824. The Botanic Garden, the University Library, the Pathology Museum, the Natural History Museum and the Comparative Anatomy Museum were instituted. Specialist libraries, museums, and well-equipped laboratories were created with interesting liberality in compliance with the spirit of renewing the methods of study and teaching of natural sciences by developing the experimental method.

theology (1769), Giovanni Battista Borsieri (1725-1785) for practical medicine and medical subjects (1770).

Boscovich, Moscati and Spallanzani, in particular, were the expression of that innovative spirit which found its distant origins in Galilean methodology, later taken up again and exploited by the Enlightenment. This spirit was not only hostile to the old metaphysical concepts but explicitly contrary to some of the most deep-rooted aspects of Aristotelian tradition.

These were the first signs of that renewal of methods in the study and teaching of medicine and natural sciences which the Austrian Government had already carried out at Vienna University and was going to extend to universities in the whole Empire. It was the decisive, open-minded turning-point as regards the traditional way of making and transmitting science, openly breaking with the past.

Entering the age of the reform, Vienna gradually called, with the same criteria, the most important of the following: Giacomo Rezia (1745-1825) for anatomy and surgical institutions (1772), Giuseppe Zola (1739-1806) for ecclesiastical history (1774), Luigi Cremani (17481830) for criminal institutions (1775) and later civil institutions (1783), Giovanni Antonio Scopoli (1723-1788) for chemistry and botany (1776), Bassiano Carminati (1750-1830) for medical subjects (1778), Alessandro Volta for experimental physics (1778), Pietro Tamburini (1737-1827) for moral theology (1778), Samuel Auguste Tissot (1728-1797) for medical therapy (1781), Antonio Scarpa for anatomy and surgery (1783), Johan Peter Frank for clinical medicine (1785), Francesco Antonio Alpruni (1732-1814) for moral theology (1780) and then for constitutional law (1797), Lorenzo Mascheroni (1750-1801) for algebra and geometry (1786), Tommaso Nani (1757-1813) for civil institutions (1795), and, finally, in the transition period between Austrian and French rule, Giovanni Rasori (1766-1837) for medical pathology (1796), and Luigi Valentino Brugnatelli for chemistry (1796).

The new didactic methods for medicine and natural science, largely based on experimentation, were left to the teachers' initiative, sometimes creating not little reservation and concern in Vienna because of their unconventionality.[24]

The reforms were very far from the simple idea that putting together many learned men was enough for a cultural and scientific revival of the University; they anticipated new structures, precise regulations and suitable financial means in order to enable the scholars to work at the highest scientific and didactic levels. The prudent freedom

[24] Spallanzani was undisputedly the prime mover in such changes as he abandoned the mainly descriptive, systematic methods of the past. He left the majority of scientific elaboration to direct observation, so that students in charge of experiments could be put in the condition "not to mix the opinions of philosophy with the answers of nature" and were "free and safe from any prevention". Adding "the system to observation", he stated there would be a great result "by accustoming the young to observe in that part of knowledge concerning natural history, they will be able to take advantage of the other part which they will apply of their own free will. Therefore, the spirit of observation is not limited to natural Philosophy or to any other part of Physics. It is instead the universal spirit of science and arts".

granted to teachers on the scientific choices which accompanied the reforms and which is evident in the *Piano Scientifico*, may come as a surprise if one thinks of the always careful, suspicious centralizing absolutism of the Vienna Government. However, it does not surprise much if one considers the personalities of high cultural and diplomatic profile such as Carlo Firmian and later Johann Wilzeck shrewdly chosen as mediators with the University and its teachers and scholars.

Not a few were pressed to go abroad on "literary journeys", even long ones, to confront other cultures and buy books and instruments, sometimes without expense limits.

By transmitting the *Piano di Direzione* and the *Piano Scientifico*, Vienna underlined that "the best plan was placed in the teachers' ability and in their known value". The call of students from any part of Italy and from beyond the Alps was immediate and in a few years there were more than a thousand.

The inherent value of the lecturers who were already illustrious before their call (together with not mentioned minor ones), the consistency of spatial and instrumental structures together with the intelligence of the mediators with Vienna was to lead the University, in few years, to that European position of great prestige, respect and consideration which it kept for almost one hundred years, in spite of the difficult political and military events which, were to involve the Austrians, French and Italians – in particular the Lombards – after 1796 for a long time till national Unity.

It was an important moment in the history of Pavia University.

Spallanzani, Volta, Scarpa, Frank, Mascheroni, Scopoli, Tissot and, later, Rasori and Brugnatelli were among the most important exponents of scientific culture – in particular naturalistic and medical – at the end of the century.

A careful observer of the European scientific world, the English botanist James Edward Smith, had visited Pavia and the University (1787) and noted:

> This is at present the most celebrated university in Italy, and perhaps better furnished with able professors, men of real genius and activity, than most at present existing in the world.[25]

The State was still dominant in the reform of ecclesiastical studies carried out by Joseph II, ordering the subjects and the observance of the Catholic religion, and rigorously controlling the Church's life and activity. The clergy's religious and civil education had to be a prerogative of the State and the interference of the papal authority or of any other extraneous authority, such as, for example, the Jesuits, could not be tolerated.

The secular and regular clergy were obliged to attend the University. All the clerks who wanted to become lectors in theology at Monasteries, Convents and Colleges of the State of Milan were supposed to get their doctorate. All the students

[25] SMITH (1793).

of the Seminary were in any case supposed to attend the courses of theology and canon law at the University.[26]

Finally, the Austrian reforms found a further and meaningful affirmation with the foundation of the German-Hungarian College.[27]

The creation of the College was part of the anti-Roman politics and theological jurisdictional reforms of Joseph II's absolutism. Its Jansenist layout was also due to the fact that Giuseppe Zola and Pietro Tamburini were called as directors – the latter was later dismissed (1794) from University teaching and College direction under pressure from the Church – both precursors, together with Natali who had preceded them, of the Jansenism condemned by Rome.[28]

The model was in many respects that of the German-Hungarian College of Rome and intended to provide culturally and ascetically prepared priests. The College differed from the model in the spirit and content of the teaching plans – prepared by Zola and Tamburini – which contrasted with the "Roman" ones. According to Zola, the Rector of the College, here "learned and open-minded ecclesiastics" were to be properly trained "for the true and greatest good of the Church". The young men, once their studies at Pavia University were completed, had the privilege of the chance to be soon called for important ecclesiastical charges.

The College was imposingly situated in the convent of S. Francesco di Paola – founded in the fourteenth century – opportunely refitted by Pollack with Piermarini's supervision. It was well directed and organized and had very strong foundations, even from the economic point of view. After twelve years of activity it was overwhelmed by the political events of the time. In November 1796, by means of a Napoleonic decree, "the buildings and goods of the College were taken over by the French Republic as an institute of a defeated State".

[26] This arrangement led, as a consequence (1786), to the institution of a big Seminary in Lombardy, a unique breeding ground for ecclesiastics independent from any power except that of the King. The Seminary was situated in the Convent of St. Thomas and the ancient Episcopal Seminary. Maria Theresa and especially Joseph II, though good Catholics, openly fought against the prevailing and often abusing of ecclesiastical power, especially that of the religious Orders, when they considered it right and consistent with their high sense of the State.

[27] In 1781 Chancellor Kaunitz, with a letter dated November 15, informed Firmian that someone in Vienna had come up with the "suggestion of conveying to [Pavia] the students of the German-Hungarian College S. Apollinare in Rome" and in particular "for that portion which corresponds to the rents it owned in Milan". This is the first manifestation of Vienna's will to institute a new University College in Pavia which was later to be the German-Hungarian College.

[28] In the spiritual and political climate of Joseph II's Empire, Jansenism, which among other things proposed a return to evangelical purity, openly developed in the University environment of Pavia. This also showed that the University was an open training ground for thought and that theological doctrines, and any other university discipline, were professed with free critical spirit in their new methods and contents, often with extraordinary results. With the call of Natali, Zola and Tamburini, the University of Pavia characterised itself as the centre of Joseph II's religious policy in Italy.

The French Rule and Related Reforms

1796 was a difficult year of great confusion and bewilderment. The University was closed by Vienna with the approaching of the French army; it was then reopened, the following year (April 28), thanks to the support of Paris. Soon the proposal was made to give back the ancient splendour to the University which could boast "d'avoir contribué à répandre la lumière sur l'Europe".

However, in May, a great number of citizens revolted against the French with ensuing occupation, repression and sacking which seriously damaged the town's patrimony. The University was respected – at least to a certain extent – also thanks to the intervention of Napoleon who soon manifested the desire that the University "célèbre à bien des titres", should start again to work at levels worthy of its ancient prestige. The museums, laboratories and libraries remained almost intact, apart from the removal of some collections of books and scientific material.

The university environment was troubled and divided by old and new grudges, suspicions, rivalries and envies. This was also due to some people's relaxed attitudes in taking up political charges, sometimes due to a true republican spirit but often to ambition for power or economic convenience. The same permanent bad mood because of delays in paying salaries and in allocating endowments was added to all this. A lot of people followed the new ideas brought from France, others stayed at a prudent distance, the usual majority of the undecided stayed in the centre.

The occupation of Lombardy by the Austro-Russians, taking advantage of Napoleon's "distractions" in Egypt (April 1799) caused further, much more serious trouble. The University was suppressed and the teachers were removed; a lot of them went to prison and others were proscribed.

When the French again defeated the Austrians (June 1800), an end was put to this brief but unlucky period. The First Consul soon decreed the opening of the University and, in so doing, he guaranteed all the necessary support to teachers, students and citizens.

However, already during the first Cisalpine Republic, the general financial situation started to deteriorate. The thirteen months of Austro-Russian occupation worsened the situation and the second Cisalpine Republic was to make it even more precarious. It improved later, at least in some respects, with the Italic Kingdom.[29]

Nevertheless, the good intentions were followed by actual facts. Some teachers were invited to meetings in Lyons and the University was recognized, together with

[29] The army needed money and its needs were met by systematically sacking public and private resources including the University. Salaries and job opportunities were reduced, several chairs were suppressed and many lecturers were pensioned off or dismissed; remuneration was always provisional and so were the arrears. However, the troubles went back even further to the last years of Austrian rule as consequences of Leopold II's (Joseph II's successor) disengagement in Lombardy. Such a situation was to last, and even worsen, for many years.

that of Bologna – through a legislative provision of September 4, 1802 – as a National University of the Italian Republic.

Cultural functions and scientific activities were to flourish significantly even despite a certain military stamp on the academic world and in spite of the impoverishment of financial resources.

The *Piano di Studi e di Disciplina per le Università Nazionali* was issued by vice-president Francesco Melzi d'Eril in 1803. It was divided into three Classes: mathematical and physical sciences (including natural, chemical and medical disciplines), moral and political sciences, literature. Within these three Classes, the subjects taught were arranged very differently from what the Austrian reforms provided for; the Faculty of Theology was suppressed.

The basic trend was to give the various schools a professional bias rather than a scientific one. Nevertheless, such a tendency was controlled by compelling all first year students of any Faculty to attend courses in geography, algebra, Italian and Latin oratory. The students of law and medicine also had to attend the courses in Greek language and literature, so that, for everybody, scientific and humanistic lessons were preparatory to professional ones.

Lecturers were appointed by the Government for three years, within sets of three chosen by the professors from among the teachers in secondary schools. After the triennium they might either be removed by those who had elected them or become established and irremovable. From 1807 onwards, professors were appointed via a state competitive examination.

During French rule, some of the major professors were the following: Siro Borda (1761-1824) for medicine (1800), Giuseppe Jacopi (1779-1813) for physiology and comparative anatomy (1800), Adeodato Ressi (1768-1822) for public economy (1800), Vincenzo Monti (17541826) for oratory and poetry and later for Latin and Italian oratory (1801), Vincenzo Brunacci (1768-1818) for "sublime" mathematics (1801), Gian Domenico Romagnosi (1761-1835) for civil law (1807), Ugo Foscolo (1777-1827) for oratory (1808). Mauro Rusconi (1776-1849), an embryologist and comparative anatomist, and Agostino Bassi (1773-1856), a biologist, did not have official academic positions, but their deep and prolonged scientific relationship with the academic world was to allow them to make a profound contribution to the spread, which took place essentially in Pavia, of those sciences today called biological sciences.

Differently from what happened during the first and the second Cisalpine Republics and in spite of financial uncertainties and difficulties, the Napoleonic Kingdom was to stimulate – also thanks to the lecturers' intrinsic value – a great flourishing of studies, as well as the development of scientific structures. That new spirit of genuine supremacy, which, to some extent, can still be traced back to the original Austrian one, was enhanced. Borromeo and Ghislieri Colleges ran serious risks but lucky circumstances saved them.

The effects of the new rules, in fact, were to be beneficial also on relationships with the high schools of the French Empire both to promote general culture and scientific research. Fatally, academic and cultural relationships with the Austro-

German world weakened; but such a change in relationships was to have a positive influence due to the effect of the environment, the Empire which was gradually establishing itself as an authentic melting pot of lively, fertile and open-minded ideas in all fields of knowledge, with undisputed supremacy over other European countries. The University was to benefit extensively by this and, thanks to the value of its teachers, the severity of the studies and the strength of its organisation, easily managed to maintain its European place. However, the other side of the coin showed a certain cultural dependence on France, which was what Napoleon wanted. This was inevitably negative for the ensuing "psychological indoctrination and subjection to the culture of the regime".

The Second Austrian Rule and New Reforms

The second Austrian rule (1814) was not to cause serious problems to the University, which continued without serious interruption, even amid perplexities and uncertainties, in its educational function. In 1816 the Emperor Francesco I had already visited the University and attended one lecture by the physicist Pietro Configliachi (1777-1844), Volta's successor, and the new Austrian Government soon declared itself in support of the University. Therefore, in a short time, Giuseppe Marchesi's plan to complete the building of the University, in order to increase the areas for libraries and laboratories as well as the archive, was accepted. These works were approved and then carried out in two years, and inaugurated in 1821.[30]

New regulations for studies (1817) and general University regulations (1825) were prepared and carried out. The *Istituzioni per l'Attuazione degli Studi* (1817) provided for three Faculties: Law, Medicine and Philosophy. The last also covered the courses for engineers and land-surveyors. The institution of a Faculty of Theology had been considered but it never happened. Instead, a provisional (1814) and then definitive (1847) Faculty of Mathematics was instituted. Consistently with the scientific progress of the time, the regulations of the Faculty of Medicine and of the Faculty of Philosophy-Mathematics were considered more highly and received a greater wealth of teaching. In fact, with the new regulations, the mathematical, physical and biological disciplines were to improve considerably, reaching, on the whole, extremely high quality levels. On the other hand, the legal, literary and philosophical disciplines were kept in the background, though they were cultivated by diligent teachers to whom we owe the great merit of keeping alive a tradition of great cultural richness.

[30] They consisted in the completion of the southern part of the University building including the Leano courtyard, which was divided into two parts, taking on more or less the current configuration. Later, the monumental grand staircase was built (1823), the physics theatre was restructured (1828) and the building of today's Aula Magna was started, as the transformation of a church of the demolished Oratory of S. Maurizio connected with the monastery of Leano (1834).

The administrative government was subject to the general regulations. Unfortunately, these were too bulky, complex and, above all, centralizing. Contrary to what Napoleonic rules required for governing the University, the Austrian rules required the presence of a large number of Directors of Studies (together with the Rector – elective – the Deans and senior Faculty members) As these Directors of Studies were appointed by the Government, they represented Vienna's will and made sure its directions were carried out. Their job was to supervise the teachers, the students and the course of examinations. They could summon the Faculties, confirm or not the Deans' nomination and, in the University hierarchy, they were the nearest to the Rector being allowed to stand in for him when he was absent. Then, every six months they were supposed to submit to Vienna a report on the course and progress of the studies in their Faculty.

The method of teaching, based on the textbooks approved by Vienna with relative liberality during the age of Maria Theresa and Joseph II, was so ancient that it belonged by then to tradition. However, while the Napoleonic Government had not abolished such a habit but merely formulated a general prescription which gave the textbook the simple function of "student's guide to the order of doctrines" and instructing them "to be prepared to attend the professor's lecture", the Restoration Government obliged lecturers to follow the prescribed textbook without any arbitrary deviation from its contents. Any change, suggested by the teacher, in such a strict scheme, had to be previously agreed on with the Director of Studies and then approved by him. The Director of Studies had to mention it in his periodical reports to the Government.

During the second Austrian rule the following teachers and scientists, among the greatest, were called: Bartolomeo Panizza (1785-1867) for anatomy (1815), Antonio Bordoni (1788-1860) for mathematics (1816), Francesco Flarer (1791-1859) for theoretical and practical ophthalmology (1819) (and going after the presence of Volta, Luigi Porta (1800-1875) for clinical and surgical special therapy (1832), Giuseppe Belli (1791-1860) for experimental physics and physics connected with mathematics (1842), Francesco Brioschi (1824-1897) for applied mathematics and advanced analysis (1858), Giuseppe Balsamo Crivelli (1800-1874) for natural history (1852)).

However, the new Austrian system was too centralized and Government appointees on university boards of management oppressively expressed the Government's will and the control of the directives of the Government itself. The Austria of the Restoration was very different from the Austria of Maria Theresa and Joseph II, and Clemens Metternich replaced Kaunitz as Chancellor. In a few decades there had been a shift from Joseph II's enlightened despotism to a non-enlightened one with Leopold II, from Napoleon's tyrannical despotism to Francesco I's paternalistic despotism. With Joseph II and Napoleon, however, the reality gave hope for the future, while with Francesco I reality simply made one feel nostalgia for the past.

Surveillance and interference in studies were often absolutely unbearable. Very different from now was that liberality and tolerance which, at least according to the *Piano Scientifico* for the eighteenth-century reforms, had given teachers huge freedom in choosing the contents of their teaching and research and had allowed

students a free choice of teachers and lectures. That liberality and tolerance had been deeply rooted in custom since the time of the Duke's *Studium* and had largely been respected in the eighteenth century Austrian reforms and later in the French ones.

Nevertheless, the stable foundations built by the previous reforms and the intrinsic validity of the most recent rules, allowed the University to keep its European renown and that prerogative of being the place where, by then, the gifted young from Italy and from beyond the Alps had been meeting for some decades. Its cultural supremacy was to last for a long time, with important repercussions on the renaissance of Italian universities when the political and economic Unity was reached.

With the Restoration and even before, the symptoms of a slow decline started to emerge. Political uncertainties and the movements of the Restoration significantly weakened cultural stimuli, moving hopes and prospects elsewhere. The presence of Vienna in the Lombard educational system was gradually weakening and the latter was anyway very different from that of the past. The University was slowly bound to come down from European heights to more modest dimensions, though always very respectable and more in line with its sister universities.

Political and patriotic events, especially in 1821 and before 1848, apparently did not noticeably upset academic life. The presence of teachers and students in the events of the national liberation of Italy, was always very great and active, with serious moral and material sacrifices. Many experienced the bitterness of an Austrian prison or the humiliation of political exile.

2.3. Volta's Teaching in Pavia

We have briefly recalled the fundamental transformations in the educational system brought about by the Austrian and French reforms and underlined the prudent liberality granted to teachers and scientific choices which accompanied reform.

Moving to the University of Pavia (1778), Volta found a new spirit and a quite singular creative will.

There was the chair of General Physics held by the Jesuit Francesco Luini (1740-1792) and the chair of Experimental Physics held by the Piarist Carlo Barletti (1735-1800). Firmian moved Luini to Mantua, Barletti to the chair of General Physics and called Volta for the chair of Experimental Physics (1778) which he was to hold for more than thirty years.[31] By calling him to the University, Firmian thought of giving him:

[31] The courses of Experimental Physics were initiated almost contemporaneously in Perugia (1730), Naples (1734), Bologna (1737), Padua (1739), Pavia and Ferrara (1742), Pisa and Turin (1748). However, the quality of teaching was very poor everywhere.

> more comfort to carry on those experiments which, because of the lack of necessary equipment, he could not make in Como.[32]

Another important presence, even if indirectly (because in Vienna), was that of Giovanni Alessandro Brambilla (1728-1800), born near Pavia, a surgeon who was to become the sole superintendent of the Empire's military health service and personal surgeon and adviser to the Emperor. He had an important role in the renaissance of the University of Pavia.[33]

Firmian had discussed Volta's call to Pavia with personalities, scientific promoters, and important contributors to science in Lombardy.

In that "bright and rich University" Volta was overwhelmed by an enormous quantity of organizational, managerial, administrative and pedagogical work. His colleagues in Mathematics and Physics were all clergymen.

The chairs and lecturers in Mathematics and Physics between 1773 and 1796[34] were:

Chairs	Years	Professors
Elementary Mathematics	1773-75 1775-82 1782-84 1785 1786-96	G. Fontana, Piarist C. Gianella, ex-Jesuit P. Paoli, Abbé substitute L. Mascheroni, Abbé
Sublime Mathematics and Rational Mechanics	1775-96	G. Fontana, Piarist
Mixed (or Applied) Mathematics	1786-1800	M. Fontana, Barnabite
General Physics	1773-78 1778-1800	F. Luini, ex-Jesuit C. Barletti, Piarist
Experimental Physics	1773-78 1778-96	C. Barletti A. Volta

The organization of laboratories proved difficult and Volta remained for a long time his own craftsman. Nevertheless, the weight of Austrian presence and attention in Lombardy started to be perceived and many things were soon to change. Volta noticed this change which turned out to be essential for his work. He had written (1777), even before being called to Pavia:

> I willingly confess that this good part of Insubria owes such great, rapid change to the wise maternal care of Our extremely Merciful Queen and to the helpful surveillance of

[32] *VE*, I, p. 298.

[33] Brambilla was an outstanding figure in Medicine in eighteenth-century Europe, promoting surgeons and establishing a school able to give a final qualification equivalent to the degree in medicine.

[34] BEVILACQUA and FERRARESI (1991), p. 215. See the paragraph *L'istituzionalizzazione della matematica e della fisica a Pavia, 1773-1796*, pp. 212 and ff., containing information on: plan of discipline of teachers-researchers, the choice of teachers, didactic programmes and their relationships, teachers' publications, textbooks and didactic methodologies, relationships with "government visitors", teacher's salaries.

> Her enlightened Ministers, and I do not stop blessing Her August Munificence and their tireless zeal with my hearth and tongue.[35]

He waited patiently for some years and finally had at his disposal a technician, the Abbé Giuseppe Re (?-1820), "a skilful and diligent machine operator".

His scientific production underwent some slowdown. In 1779 Jean Senebier (1742-1809) wrote to him:

> ... la Chaire de professeur ... Vous a été fatale, elle a endormi votre génie, elle a arreté vos découvertes. En vous donnant cette place on a rendu service à Mr. Volta et à ses écoliers, mais on a nui à la Physique et au Public ....[36]

The new spirit in the fields of research and didactics that Volta found in Pavia had its pioneers in Spallanzani, Moscati, G. Fontana, Boscovich and a few others, and a valid promoter, though prudent, alert and suspicious, in the Government of Vienna.

Spallanzani's evidence on the state of the research and naturalistic didactics and Moscati's audacious – for those times – observations on his own and Spallanzani's call to Pavia , bear interesting witness just to help us understand the spread of that innovative spirit which later was to enliven scientific creativity and its divulgation by the University.[37]

[35] *VE*, I, p. 145. The "big and nick" he had perceived involved men and things and the comparison of the University of Pavia with the relative poverty of other university seats such as Turin, Bologna and Florence, brought a certain comfort to him. As already pointed out, the only Italian seat in which Volta found valid interlocutors was that of Turin where Beccaria's school flourished; however "I have not found there any machines which is new and better than the common ones". He found Bologna a "big and crowded city but ugly, foul-smelling, dirty, with all the old rust"; as for the "natural history laboratory" and the physics laboratory they were "much worse than those in Pavia". In Florence instead, thanks to Felice Fontana (1730-1805) and others, he found "very elegant machines and mostly worked in England"; however, Florentine scientific culture was still far from that of his past.

[36] *VE*, I, p. 362.

[37] Spallanzani, who was forty years old when he was called, had already taught in Reggio Emilia and Modena and had gained wide international fame. The year before he had been admitted to the Royal Society. As a keen observer of the European educational realities of his time and up-to-date researcher, he had trained himself in the arcadian-rationalist culture, fully living the cultural evolution which was to lead to the height of the Enlightenment and pre-Romanticism. By the middle of November 1769 reading his inaugural speech at the University of Pavia – which Austrian authorities were later to allow to be published "in order to add lustre to this University and glory to Its name" – outlined his course of lessons declaring to take inspiration from the "new philosophic method [introduced] first under the guide of Galileo, then of Newton, Redi and Malpighi and finally, in our time, of Vallisneri and Reamur, not to mention others". And further on: "First of all we have to clear our soul of any preconceived hypothesis, if there is any dear one. Let's honestly question nature, let's take faithful notes of its answers without adding anything with our mind, let's compare them, let's channel conclusions as they derive the ones from the others but let them be measured, consistent, as if they flew in a sloping channel. In this way only will we be enabled to contemplate the truth, the Goddess for whom we burn with love, whom we look for

During his European travels of 1781 and 1782 (Switzerland, Germany, Holland, Belgium, France, England) and in 1784 again in Austria and Germany (in Vienna he was received by the Emperor), Volta verified that although the visited laboratories were well equipped and supplied with sometimes very sophisticated machines, the instruments he had built and employed in his scientific research and promotion of teaching were not at all inferior. Indeed, he was asked for them by many people. Everywhere he was exceptionally welcome and the relationships with scientists were exciting for him. He gradually met Benjamin Franklin (1706-1790), Georges-Louis Leclerc de Buffon (1767-1788), Jean Baptiste le Roy (?-1800), Antoine Laurent Lavoisier (1743-1794), Pierre Simon de Laplace (1749-1827), Claude Luis Berthollet (1748-1822) and others. He wrote to Firmian: "well, I am enjoying a reputation I do not deserve".

The stay in England (where, among the others, he met Joseph Priestley (1733-1804)) on his visits to London, Oxford, Blenheim, Manchester, Liverpool and Bristol, impressed him very much:

> The reason why I have so much prolonged my stay in England, is the fact that it is such an interesting country that it is not possible to visit it quickly and it is difficult to part from it.[38]

with anxious constancy, whom, once found, fills our soul with a very soft sweetness" (from SPALLANZANI (1770)). In the same year, introducing Charles Bonnet's work, *La contemplazione della natura*, he had translated and enriched with notes and expanded, he confessed his bitterness for the state of neglect of naturalistic studies in Italy. "It was difficult to spread the taste for natural knowledge which was so sleepy and languishing nowadays in Italy". Moscati was a critical and innovating expert in didactic and scientific methods. As a supporter of the anatomical approach of medicine, in conformity with Morgagni's teachings, considered anatomy and pathological anatomy the fundamental knowledge of diseases and the art of treating them. He played a relevant role in the renovation of medical art in Austrian Lombardy and later in the French one. In 1770, "the first year of the University's restoration", he made his inaugural speech on *Delle corporee differenze essenziali che passano fra le strutture de' bruti e la umana* referring to themes which had already been discussed by Jean Jacques Rousseau in *Discours sur l'origine et le fondament de l'inegalité.* On the basis of anatomical subjects he had resumed with daring the defence of the original quadrupedism of men. Moscati said "if the anatomist were able to demonstrate that the human body, as a material body, is absolutely not superior to that of brutes ... it be clear that, as a consequence, the man, declared by all the phenomena of his life infinitely superior to brutes, is such for any other reason but his body organization". His inaugural speech scandalized not few people, scientists and non-scientists; however, it was indicative of the new modern and unprejudiced atmosphere from which the restored University had started.

[38] *VE*, II, p. 123. "... far from finding in England that supposed decay and weakness, there is strength and vigour which one does not meet in any other nation. Commerce seems to have increased, at least gold circulates very fast. The riches of individuals are immense, the class of well-to-do people is very extensive. The workman is well dressed, better fed and, in spite of all the taxes, he has some money left to throw away in taverns. There are industries everywhere, new manufactures and new businesses. Public entertainments, which in France and Holland are suffering like commerce from the disastrous effects of war, and are decaying and diminishing, in England seem to multiply. Here, not even a quarter of Holland's and France's complaints about the war are heard ..." (*VE*, II, pp. 129-30).

Though scientifically late in comparison with France, England had by then entirely entered the technological revolution, whose implications and opportunities Volta fully grasped. However, England was coming out from the war against France, Spain, Holland and America.

Different from many of his colleagues, Volta was open, though with a certain prudence, to didactic, scientific and applicative innovations and supported them too. Comparison with his colleagues, especially foreign ones at the highest level, stimulated him to widen the horizons of his knowledge as well as to make new experiments and try new didactic methods.

As we have already said, however, the only school which influenced him, at least at the beginning of his activity, was that of Beccaria in Turin. One can thus understand his wish to travel, especially abroad, where he found his most interesting interlocutors and started his most important correspondence with several foreign scientists. He deeply loved his land and, when he noticed how the Italian scientific world was absent from the debates he took part in abroad, he felt discouraged.[39]

The cultural and political presence of Pavia University, as well as its growing prestige in the European context, created in Vienna understandable attention and apprehensions, manifested either through directives on didactic problems which often involved teaching methodologies themselves, or through the requests for detailed reports on general school activities. It could not be different in relationships between a Government which personified centralizing absolutism and a *Studium* whose very high prestige derived largely from the scientific and cultural prestige of strong personalities already well-known in the international circles they were close to.

Such continuous vigilance manifested itself in forms which were particularly careful with regard to those scientific activities which, moving then to the didactic ones, followed paths almost beyond what was accepted at that time. For example Spallanzani's research into could cause upset in a Government which, besides being absolutist, was also strictly Catholic. Spallanzani was creating a new didactic and scientific methodology for Natural Sciences: the foundation of modern Biology.[40]

[39] In 1786 he was in Lausanne where he was struck by the general enthusiasm for glaciers, for "the highest, steep mountains", especially after the ascent of Mount Blanc achieved by Horace Benedict de Saussure (1740-1799) one month before. "Foreigners from all nations (except Italians)" took part in this enthusiasm. He felt alone and isolated, belonging to a land which then was still deaf to stimuli of initiative, if not of adventure; a land which was on the whole indifferent, if not extraneous, to the novelty being so tenaciously looked for in the most advanced European states. Some years before he had appreciated the experiments of the Montgolfier brothers (Joseph-Michel (1740-1810) and Jacques-Etienne (1745-1799)) with hot air aerostats (1783) but more for the technological effort and the novelty they represented than for their scientific importance.

[40] In his relations with the powerful, Spallanzani was very careful and skilful; very careful not to fall into the web of the Inquisition, he was skilful to avoid any possible involvement in religious and political controversies. He manifested with everybody his firmness in defending his rights as a researcher and he usually had no difficulty in doing it; with his colleagues however, who certainly

Pavia teachers were fortunate to have the careful Firmian as their contact with the Government of Vienna. With the tact and prudence of high diplomacy, conveyed Vienna's directions to Pavia, suggesting possible solutions for the various controversies which, substantially, left lecturers enough freedom to work as they desired and, in many cases, to do whatever they wanted. He was "protector of science, of literary men, promoter of fine arts".

Firmian's tact and prudence mirrored the University teachers', the large majority of whom kindly proved to be good subjects of the Empire. At the same time, they firmly refused to renounce their independent fundamental prerogatives as free researchers, even when they asked for financial means for research, demonstrative experiments and "literary travel".

Vienna's prudent liberality, skilfully handled by Firmian, also derived from the intrinsic cultural, scientific value of those teachers, and not others, whom Vienna itself had looked for and wanted for their "great renown", and for the promotion of the University to the highest levels.

Vienna manifested its own liberality also granting the teachers a lot of mobility both inside and outside the Empire's borders, often soliciting (Firmian and Kaunitz) people to undertake those "literary journeys" which Spallanzani, Volta, Scarpa and others were to amply profit from, as well as engaging them in teaching for half a year only and, sometimes, passing over prolonged absences from the University chair.

Firmian, an "incomparable gentleman, born for the good of everybody", died in 1782, after 23 years devoted to Austrian Lombardy's welfare. He was replaced as plenipotentiary for Lombardy, by Johann Joseph Wilzeck. Joseph II and Kaunitz's interventions were to become more and more incisive.

On the occasion of the trip to Austria and Germany together with Scarpa (1784), Volta obtained permission to:

did not belong to the powerful, sometimes he was ungenerous and sometimes wicked as it will appear further on in connection with a bad episode in which also Volta was involved. Spallanzani himself many times complained about these attentions which, in not few respects, could also appear censorious; suffice is to say that the discussion with the Government of Vienna, through Firmian, on his proposal to adopt as didactic text Bonnet's *La contemplazione della natura* which, enriched with his notes and additions was, in his opinion, particularly suitable for a university course. Vienna did not like this proposal because this text did not give enough space to the systematics or "nomenclature" – classification of plants and animals according to rigid schemes – to which Spallanzani usually did not give any importance, while he agreed with that experimental approach of the modern and audacious research he tenaciously pursued and which worried Vienna so much. Spallanzani did not think highly of the systematics of the "nomenclature" whom he considered "notaries, unfit administrators of a patrimony they were not able to enrich". Nevertheless, apart from some episodes of this kind, the vigilance on teaching normally dwelt essentially on formal and methodological aspects rather than on its contents. But what annoyed the University teachers, and in particular Spallanzani, was the awareness that Vienna's vigilance on scientific and didactic biases and choices came from their colleagues of Vienna whom they, on average, did not think highly and vice versa.

> supply myself, whenever I might find some during my travels, with good instruments of physics, for an indefinite sum, at my discretion.[41]

Volta, when he was not travelling abroad, freely divided his time between Pavia and Como. The Government of Vienna, absolutist, centralizing and strictly Catholic, never imposed particular ideological and philosophical schemes upon the University teachers. Religion, metaphysics and politics very often did not find any space in scientific laboratories.

Even if teachers found the plenipotentiaries for Lombardy were careful mediators in relations with the Government of Vienna, so that even bitter conflicts could find acceptable solutions with mutual kindness and firmness, this did not happen in the relations between the colleagues of the University. Backbiting, gossip, envy, more or less justified bad moods, jokes sometimes in bad taste, derision etc., even between people endowed with intellectual insight or a strong character and used to the free and unprejudiced exercise of their mind in frontier researches, were certainly not absent.

Volta himself paid for it and more than once.

First of all, in his private life when, dazzled for some years by the soprano Marianna Paris, he tried to overcome the opposition from his family, colleagues and authorities to his plan of marriage (it seems that Emperor Joseph II in person had opposed this project).

As a teacher, because he succeeded in rousing crowds of students, curious and admirers and "varied humanity"; in fact Vienna decided to build a physics theatre for him – the "vago e comodo teatrino", as he called it, containing about 120 seats, as well as well-equipped laboratories. But the criticism about his didactic commitment was very serious.

Still as a teacher, in his contrast with Barletti who, prompted by envy, criticised his didactic commitment, a contrast which later deepened for political reasons (1796).

As a public man, when he was accused to be "pro-Austria" or "Jacobin" depending on the winning flag.

Still in his private life, when Napoleon appointed the "pro-Austria man" senator and earl of the Kingdom of Italy.

As a teacher and scientist he was prey to some colleagues' derision as well as severe and ungenerous judgements, in particular by Spallanzani whom he had always considered as a good friend.

In August 1787 Spallanzani writing to Senebier hit at Volta's weakest points as a teacher and scientist; he pitilessly underlined Volta's real limits and deficiencies:

> Thank him [Bonnet] infinitely for his kindness to me, and tell him he will do me a real favour in rebuking Don Alessandro Volta who, in Pavia and outside Pavia, had always proved to be my enemy, though not so openly nor with the same obstinacy as that practiced by my other enemies. Nevertheless I reply to you that in Pavia and outside

[41] *VE*, II, p. 247.

> Pavia I have always spoken well of him; and when I left for Constantinople he proved one of my best Friends. I'll tell you more, that on many occasions I did my best to take his side against the bad reputation he universally enjoys as regards his learning and which is mostly true; that is to say that he is a Professor of Experimental Physics who, apart from few branches of this Science, that is Electricity, Air and Fire, does not know anything else, ignoring Algebra, Geometry, Mechanics so that at school he is not able to speak about these two or three branches. which is a serious drawback for his students. All these things are well-known, nay, I'll tell you in confidence that when he comes to Milan he will be almost rebuked as Scarpa was for anatomy and he will be compelled to change his method" [Scarpa had been "... admonished for doing his School of Anatomy very badly, and obliged to give the list of the number and qualities of his lessons to be then submitted to the Superior judgement of the Court and the Government"].[42]

These opinions by Spallanzani must be connected with a bad episode which happened the year before.[43]

[42] Geneva, Bibliothèque Publique et Universitaire, Ms. suppl. 1043 (c. 108).

[43] In 1786 Spallanzani, temporarily absent from Pavia because on a trip to Constantinople, was accused of having taken some exemplars from the Laboratory of Natural Science to enrich his own museum in Scandiano. Coming back to Pavia, Spallanzani fully justified his action and his accusers were "... harshly admonished in the name of H.M., with the threat of losing their chairs if they still speak about this event ..." Among the accusers were Scarpa, Scopoli and Canon Serafino Volta (who was not related to Alessandro), the attendant of the Laboratory of Natural Science who later, because of this episode, was even removed from his office. Spallanzani took his revenge by playing a bad joke on Scopoli: he prepared the crop of a chicken in wine spirit and, after closing it in a jar, he showed it to Scopoli who did not hesitate in classifying it as a new species! The episode was made public and made everybody laugh. Spallanzani, not yet satisfied, printed a booklet hiding himself under the name of Francesco Lombardini (SPALLANZANI (1788)). The booklet contained ironical and insinuating opinions on Scarpa, Scopoli and Volta. Indeed, the latter was simply guilty of being a good friend of Scarpa and Scopoli and was extraneous to the accusations aimed at Spallanzani, In fact, writing to Senebier, Spallanzani admitted that, of the three, Volta was the least malicious towards him. It is not unlikely that Spallanzani, giving credit to gossip, had mixed Alessandro up with Serafino because of their same surname. Thus, Volta did not escape the irony of Spallanzani who, on page 33 of his booklet stated (the following quotations can be found also in *VE*, II, pp. 541-2): "We know that Dr. Alessandro Volta is Professor of Experimental Physics at the University of Pavia, who, just speaking of the different airs, heat and electricity has some merit. It is a pity that, in spite of his great intentions, he is almost useless for his students. Since he has not touched the principles of Geometry, Algebra, Mechanics and other similar disciplines, he is condemned to speak for ever of airs, heat, and electricity, without ever being able to hold an accomplished course of Physics. As a consequence, leaving the machines of Optics, Statics and Hydrostatics dusty and useless, he for ever trains the young in what concerns the discharging of his pistol and the lighting of the small candle by inflammable air, which are nothing else but two child's games of physics. This turned out to be a disadvantage for him because the Barometer-dealers, his countrymen and friends, took them into different parts of Italy and also out of it, had boasted about him so much as to make him feel the most famous physicist in Europe, without dealing from morning to night with anything else but doing nothing". Further on, at page. 46, Spallanzani addresses Scopoli thus: Isn't it true that some years before, in order to gain some money, you held a Course of Chemistry at home (which soon failed I do not know why). When

Spallanzani's observations deeply hurt Volta. Spallanzani was a liar when he wrote to Senebier saying Volta had "always proved to be his enemy" and Spallanzani was ungenerous hitting at Volta so hard as a scientist and a teacher. The letter to Senebier was private. On the other hand the booklet was public and very libellous. Volta however, well provided with self-control, refrained from giving a public reply. By repeatedly clarifying the real facts about the bad episode, Volta tried eventually to restore good relationships with Spallanzani.

The Government of Lombardy passed over this last episode, considering it nothing more than gossip.

In a letter-report of April 1788 requested by the Government Council, Volta explained his ideas on the contents of the entire course of Physics, distinguishing the part concerning General Physics from that concerning Experimental Physics:

> Therefore, following the order and method of all the Courses of Physics, it will be the task of the teacher of General Physics to give, after the prolegomena of Physics and after having explained the general properties of bodies, putting aside vain, useless questions and everything too speculative that one finds in many works, and above all insisting on what, around these same general properties, teaches observation and experience, it will be that teacher's task to give also the principles of Dynamics, Mechanics, Hydrostatics and an idea of the System of the World. I repeat, he should give the principles of these Physico-Mathematical Sciences, leaving to the teacher of Sublime Mathematics, and especially to that of applied Mathematics, the task of duly developing the theories especially of Mechanics and Hydrodynamics.
>
> As for experiments relating to the general properties of bodies, the laws of motion and the fundamental principles of Statics and Hydrostatics, which will belong to the Professor of General Physics, we have agreed [Volta and Barletti] that, besides the first two academic

experiments were needed, they were usually performed by Professor Volta who, being able to do only those of airs, electricity and heat, after having bored students at university, bored them again at your house, so that, as the experiences were the same and presented in the same order, after the first, the following ones could be guessed, as passages of ordinary music or lines of bad poetry are". Still further on, at page 129, he wrote: "When all Pavia was laughing at the expense of the author of the bladder worm or crop worm, thinking of a Comedy in imitation of Goldoni's *Antiquario*; Professor D. Alessandro Volta was the only one who did not find anything to laugh at, claiming that there was not much difference between a chicken's crop and a worm. Therefore, I add, the Philosopher from Como had not ever seen till then a snail, a slug, a earth or human worm, an oyster, or any other worm; had he seen them he would have never uttered such nonsense. How can that man, not content with the poor show he makes as a teacher, try to make himself look ridiculous in Natural History too, which he does not know, unless he looks it up in a Dictionary? How can it be possible that, instead of fostering the bagatelle, of spending the whole day in visits, of smelling around for the house with the richest banquet, he does not start seriously studying a Course of Physics, without neglecting the elements of Geometry, Algebra, Mechanics, Optics, about which he is very innocent? How is it possible that he does not see the necessity of these elements especially now he has made it compulsory for Engineers to attend his school, to whom he should teach Mechanics, but, ignoring it completely, he teaches only electricity, airs and anything else except what can be helpful to the Engineering profession?".

> months, November and December, he should also have June, which is more comfortable for Hydrostatics experiments than the winter months; thus leaving me the intermediate five months for the much wider and varied experiments of Particular Physics, on Fire, Light, Air, Vapours and the other elastic fluids, on both artificial and natural Electricity, Magnetism, Meteorology, etc.[44]

The planning of the course agreed on with Barletti was correct. To General Physics was left the discussion of that by then relatively "well-established" section and to Particular Physics the discussion of that part which was still "in progress" because of some either theoretical or experimental contributions.

This planning was, on the other hand, entirely consistent just with Spallanzani's ideas. He had always claimed it necessary for students to know, via direct experimentation during the lecture, the most recent scientific development of the subjects being treated. Volta held the chair of "Particular and Experimental Physics", so this task was clearly within his competence. Spallanzani, however, was right in saying that Volta was "very innocent" in Geometry and Algebra.

Nevertheless, even though Volta was well-disposed towards Spallanzani, almost ten years after (1794), when the controversy with Galvani was by then fully developing, Spallanzani who was "against those who badly repeated Galvani's experiences", wrote a letter to Abbot Paolo Spadoni from Bologna, in which he stated, with renewed hostility:

> Today Alessandro Volta graduating some Engineers has read a very, very long discourse, all against Mr. Galvani's electricity. He has tried to demonstrate that this electricity must not be called *animal* but rather *metallic* since it was, in his opinion, a pure play of armatures. He relied on several experiences of his which, according to his habit, swam in a sea of words. However, he has not been able to take away from the minds of his colleagues the ideas, founded on facts, that electricity is really animal. I believe that the speech he read will be soon published by him. It will be similar to his other memoirs. This worthy Colleague of mine has an inventive spirit, but his head is filled with precarious hypotheses, lacks the logic of the observer and he is always boring in expounding his ideas.[45]

In a letter to Leopoldo Giuliani,[46] Political Chamber-Magistrate in Vienna (January 1795), Volta returned to the theme of public hostility towards him, both academic and non-academic. He referred to the malevolent criticism his friend Frank – who had meanwhile been called back to Vienna (1795) – had been a victim of, from "vile detractors" who tried "with cabals and frauds to depress and eliminate [besides Frank] other Members of this flourishing University of ours and me in

[44] *VE*, II, pp. 430-1.
[45] Florence, Biblioteca Nazionale Centrale, Raccolta Gonnelli, cart. 36, n. 198.
[46] *VE*, III, pp. 241-6.

particular".[47] He also referred to Spallanzani's malevolent criticism of almost ten years before and, in particular, he complained about the fact that on that occasion "... the Government has not redressed it in any way ..." and the fact that a few days before his letter even the academic organs (Rector and Consistory) had validated in official documents the "... unfavourable information given by some private citizens who took sides against me, whose groundlessness and falsity they could have easily found out ...", official documents which "... among other things not so well conceived, [reported] in two articles strong expressions of disapproval and condemnation against me and against the Machine operator and assistant of the Physics laboratory, Ab. Re". He explicitly asked for the crossing out of "... those two articles so that they could not remain as evidence of his undeserved disrepute in the proceedings of this University".

Then, referring to his letter-report of 1788, he passionately and truthfully defended his work done as a teacher, using various arguments to confute the criticism which continuously came against the layout and programmes of his teaching.

In reply he received assurances on the esteem and consideration in which he was held at the Court and Government of Vienna. They believed he had probably been a victim of hateful misunderstandings and that everything would be resolved.

Nevertheless, these episodes we have deliberately reported, and their prolongation in time, reveal an environment, specifically the academic one, which, to a certain extent, was hostile to him. One has to give credit to his biographers who attributed this situation to envy and jealousy rather than to substantial facts. Though comprehensible from the mediocre, such envy and jealousy comes as a surprise when it involves personalities of high cultural profile such as those surrounding Volta.

Deep political and social transformations, however, were near. During the last decade of the century the Court of Vienna changed attitudes and policy. The provident, tolerant presence of the Austria of Maria Theresa and Joseph II in Lombardy was by then drawing to its end.

Joseph II died in 1790 and Leopold II succeeded him. Leopold II, in his two years of reign, was to carry out a large number of the reforms promoted by his predecessors.

The French Revolution directly or indirectly affected European States and Leopold's attention focused completely on France; Napoleon's army was ready to invade Italy.

Maria Theresa and Joseph II had found precious collaborators, as authors of their reforming plan in Lombardy, such as Anton Kaunitz, Carlo Firmian, Joseph de Sperges, Gerhard van Swieten, Johann Joseph Wilzeck. They had also found several precious interlocutors among the "homines novi" (politicians, functionaries, technicians, learned writers, people of different cultural and regional extraction open to the spirit of the reforms, despite remarkable conflicts and differences of ideas)

[47] Frank had been called to Vienna by the Emperor who appointed him director of the "Universal Hospital". For the University of Pavia this was a serious loss.

such as Pompeo Neri, Beltrame Cristiani, Gianluca Pallavicini, Luigi Giusti, Gianrinaldo Carli, Paolo Frisi, Cesare Beccaria, Barnaba Oriani, Pietro Verri, Luigi Lambertenghi, Michele Daverio, Niccolò Pecci, Giuseppe Pecis, Antonio Greppi, Giovanni Alessandro Brambilla, Giuseppe Cicognini, Giovanni Bovara and others, together with relatively young and highly professional administrators.

They were among the main authors of the cultural, political and economic renaissance of Lombardy; in particular, of the rebirth of Pavia University and of its full European position.

The University was closed by Vienna while Napoleon's army was approaching (May 1796). It was later reopened, with the support of Paris. Napoleon's open attitude towards culture and the men representing it was certainly authentic. More than once he had showed – and was to show again later – that he appreciated the consideration and friendship "des gens de lettres" recognising himself as one of them.

The ideas of Revolution found widespread support first in Lombard intellectual circles and, in particular, in the seats of learning. At the University of Pavia discussions and controversies were very lively and often violent. Alpruni, G. Fontana, Mascheroni, Barletti, Rasori and others adhered to the new ideas; Rezia and Spallanzani sympathized but with prudence and detachment; others were hostile, often not manifestly but with discretion, abstention and agnosticism. Scarpa was openly hostile and Volta, prudently sharing his ideas, considered his resoluteness exemplary; others were uncertain or indifferent.

The academic environment split into opposed factions, old and new rancour cropped up both inside and outside academia, in a climate of great confusion, uncertainty and bewilderment.

The pleasant, reassuring atmosphere that the tolerance of good government had created between citizens, students and teachers, was breaking up. The traditional meeting points soon turned into points of ideological clashes between Jacobins, the uncertain and the pro-Austrian.

The transfer of the University to Milan was suggested and Volta was accused of supporting it. In fact, he limited himself to suggesting moving teachers and students "temporarily to Milan", which was "farther from the war movements", giving his reasons in a memorandum.

The proposal of the transfer was rapidly withdrawn but Volta remained deeply upset by the hostility manifested by town's people towards him, "with words of mistreatment and menaces".[48]

[48] On November 4, 1796 Mascheroni communicated to Giuseppe Mangili (1767-1829), Spallanzani's successor, the piece of news of the opening of the University (October 22) and the celebrations held with speeches by lecturers and town and French authorities; in particular, news on the serious and public affronts suffered by Volta with regard to this episode. The inaugural lunch took place in the Hall of Borromeo College, in the absence of Volta and many other professors: "... After lunch Volta thought it best to turn up. Besides abstaining from the lunch, he had the bold demerit in the eyes of Pavia citizens to be considered the author or the great co-

Volta, substantially conservative and moderately pro-Austrian, could hardly absorb the ideas and behaviour brought by the new "padrun" (Lombard dialect word for "masters") whom he considered rough, violent and light-fingered.

Among those who had enthusiastically embraced the new ideas from France and who were diametrically opposed to Volta, Rasori was a remarkable and singular figure.

Rasori was only thirty years old. He was Professor of Special Pathology and a follower, but critically, of the medical system proposed by John Brown (1735-1788). He had been elected Rector of the University by students, as entitled by the French authorities, in December 1796.

An eloquent, tenacious advocate of the new customs and didactic and scientific methods, his political faith was genuine and open. His exaltation and defence of the new concepts of freedom and brotherhood were of exemplary sincerity even though, almost always expressed in the rhetorical terms fashionable at the time.

Gattoni judged him "the most furious of modern atheists". But his liberal ideas, his intellectual honesty, his determination to act and some of his audacious innovations met strong opposition in the academic environment. Scarpa, Volta and others had disliked him immediately from the beginning. It could not be otherwise they both were, though with slight differences, substantially Austrophiles. Volta considered Rasori, with derision and contempt, as an "extreme patriot, revolutionary and atheist".[49]

operator in the project of transferring the University to Milan. So rumours soon circulated warning him he was looked askance at and that it would be a good idea for him to retire from there and from Pavia. Nevertheless, he even went to the "Bottegone" [the main café] and they say he made quite aristocratic speeches there. Finally, in the evening, he went to the theatre and as soon as he appeared in the box, immediately from the opposite box Teodoro Barbieri [municipalist] and others cried eternal war on Pavia's enemies, pointing at Volta. It seems that someone advised him to retire but he did not do that. So that noise went on and Barbieri approached him and said: 'For God's sake, go away from Pavia, if you want to be safe' and it seems that he also put his hand on Volta's chest pulling his jacket [...] The following day Volta left for Milan where he presented a written justification, in which he claimed to have done nothing else but give his opinion on a project made by others, adding the merits he believed he had at the University, ...". (*VE*, III, p. 327). As had already happened in the past, the presence of the big colleges (Borromeo, Ghislieri and Castiglioni) helped the decision of keeping the University in Pavia together with the opportunity of keeping the main seat of Lombard *Studia* far from the seat of political power. Thus the episode was definitely closed, though with much perplexity and reservation.

[49] The proposal of giving a military imprint to the academic world with the creation of battalions of students made up of companies under the command of teachers was poorly tolerated by Volta and it was probably one of the reasons for his disagreements with Rasori who, on the contrary, was a fervent supporter of the proposal.

In 1799, with the return of the Austrians, Rasori left the University of Pavia and never returned.[50]

Though very different one from the other, Volta and Rasori certainly were among the most important personalities in the Lombardy of the difficult but decisive years at the end of the eighteenth century; one as a teacher and scientist in the Italian cultural-scientific semi-desert surrounding him, the other because he absorbed and exalted the new ideas which were to change the way of living of many European States.

Nevertheless, despite many fears and perplexities, the arrival of the French in Lombardy did not significantly change that balance between family, scientific and academic activities reached by Volta in the 1790s. He managed to maintain this balance in spite of the incomprehension of a changing society which sometimes, as we have seen, proved hostile to him.

He did not move his family to Pavia and spent his time pleasantly, when his didactic and scientific engagements were over, between the University, the "Teatro dei Quattro Cavalieri" (he loved the theatre and very often went there "to empty his soul from daily troubles ..."), the "Bottegone" (the main café in town later became "Caffè Demetrio"), he was often a welcome and honoured guest at lunch, dinner or the "well-attended and brilliant" parties of the best-known families in town. He had at his service at least one valet (Giuseppino Canobbio was his affectionate valet for about twenty years, often accompanying him in his travels to Italy and abroad). He had horses, carriage and stable. His family lived in a state of dignified well-being.

When Lombardy was occupied by the Austro-Russians (April 1799), the University was suppressed and teachers dismissed; many were sent to prison (Alpruni, Barletti, G. Fontana, Moscati, Nocetti and others) or were proscribed (Gabba, Gianorini, Mascheroni, Nani and others).

Volta, upset and perplexed, happily retired into the quietness of his Como where completed his research on the electrical properties of the chains of conductors with the invention of the pile, by far the most important and meaningful contribution of Italian experimental science to scientific and technological revolution.

Volta's dismissal from the chair and salary was part of a general disposition involving all the teachers, without any distinction, as a consequence of the closing of the University.

Nevertheless, generously Vienna did not think that Volta had seriously compromised himself with the French.

Volta's return to his chair, as well as that of Scarpa and others, was neither easy nor immediate and, in any case, it took place not because of action from Vienna which, for all the thirteen months of its occupation kept the University closed, but

[50] It was said of him that "he was among those who opened the age of sacrifices to ensure us the age of triumph; he never ceased to be the apostle of freedom, although he knew that a failed event led to horrible prisons or to the gallows".

because of Napoleon's action: he returned to Lombardy, in spite of repeated declarations of devotion to the Austrian Court.[51]

In fact, Volta had by then become convinced that France, passing from one success to another, would definitely defeat Austria, thus strengthening its presence in Italy, and that he would have to resign himself to this situation.

He found himself isolated among the aristocrats because he was opposed by their die-hards as regards anti-French sentiments. He saw the future in France but, contradictorily, he heartily hoped for the re-establishment of the Vienna authorities.[52]

Volta's behaviour besides being contradictory was definitely equivocal; justifiable only by its clear perception and comprehension of reality.[53]

[51] In a letter lacking both the date – but certainly subsequent to September 6, 1799 – and the addressee, he complained about the wrong suffered as a consequence of his removal from office. Referring to an initiative by Scarpa with regard to this he wrote: "... It was professor Scarpa who wrote to Frank and Brambilla, complaining about the wrong suffered by him and those other teachers who had always embraced the good cause and behaved irreproachably all the time, that wrong, I say, they suffered from being involved in the general condemnation removing them from office, depriving them of money and especially of the King's grace, thus making them appear guilty and depraved in the world's eyes, like those who in fact proved to be so and promoted or favoured revolution ..." (*VE*, III, p. 462).

[52] Thus, on February 27, 1797, while in Como they were celebrating the feast of the oath of allegiance to the Republic, Volta went elsewhere with a group of aristocrats to celebrate Carnival, arousing the Jacobins' rage but without gaining the sympathies of the most conservative aristocrats. At the theatre in Como where the Carnival Ball was being held that evening, Giambattista Corbellini, a fervent Jacobin, harangued the people present inviting them to cut off the heads of nine aristocrats, among whom the "two infamous professors, Volta and Nani".

[53] The Constitution of the Cisalpine Republic was promulgated on July 9, 1797. Gattoni stated that the Statute was drawn up by "five of the most resolute Jacobin atheists of Milan, chosen by Bonaparte and printed in Milan with his approval". The oath of allegiance was made compulsory for all officers in 1798. The formula of the oath was as follows: "I [name] swear inviolable observance to the Constitution, eternal hate to the Government of Kings, Aristocrats and Oligarchs, and I promise always to bear no foreign yoke and to contribute with all my strength to supporting Freedom, Equality and the preservation and prosperity of the Republic". However, the compulsoriness of the oath raised a great outcry and endless arguments about its legitimacy or illegitimacy, in an atmosphere of general confusion and conflict between religious feelings and political beliefs. The Church considerably contributed to this confusion as a consequence of conflicting behaviour over the whole range of its hierarchy. Many clergymen, both Jansenist and anti-Jansenist, took the oath, claiming it was legitimate to do so. It goes without saying that Gattoni was tirelessly contrary. This blind aversion of his might also give rise to some doubt about the objectivity of his judgements. This is true also with regard to his criticism towards Volta, whom he never forgave for anything especially when, in his opinion, Volta confused religious sentiments with political beliefs. The teachers of Pavia University took the oath on January 28, 1798, in the presence of Barletti as Executive Commissioner of the Central Administration of the Department of Ticino. According to Gattoni, Volta took the oath and he was "among the first". Those who, like Scarpa, refused to take the oath, Paolo Ruffini (1765-1822), mathematician in Modena, Luigi Galvani (1737-1798) anatomist and physiologist in Bologna and others, were dismissed from office. Did Volta take the oath as Gattoni claims or did he not as Volta himself

Indeed, if the episode recounted by Gattoni in footnote 53 is true, it shows his incapacity to assume linear, simple and consistent political behaviour. It is difficult to contest the reproach coming to him from many sides that he was a political opportunist. His forecast of an improbable resurgence of Austria, however, and his conviction that France would win, at least for a long period, were right, as subsequent events were to prove.

With a letter, whose date is not known but certainly prior to the French return to Lombardy, Volta, still hidden in Como, without chair and students and so without money, unable to afford the expenses for his researches, asked for "honorific superannuation" at half money, as we have already said elsewhere. He appealed on grounds of the big family dependent on him and his need to return to them, once and for all, in order to keep an eye on the studies of his children who were still young. He asked, as an alternative, to be transferred to Milan as a teacher in the Brera grammar school, with the same salary as he had in Pavia as well as accommodation in Brera.

Vienna's disengagement at Joseph II's death, the first French presence and then the return of the Austrians, seriously hurt the University, creating both moral and material trouble. Uncertainty about the present and insecurity about the future for teachers and students, academic staff changes (often for ideological reasons), suppression of chairs, impoverishment of financial resources due to their being drained off to support the army and the war, cuts in salaries or delays in allocating them, were all factors which reduced confidence and prospects.

Napoleon's return to Lombardy (June 2, 1800) put an end to the unlucky period of thirteen months of Austrian occupation and the University being closed. With the Italian Republic (after the Lyons meetings) and the Italian Kingdom, the University's moral and material decline significantly slowed down but it was not stopped.

Volta soon clearly understood the negative changes, independently from his personal ideological seesaws and suffering at Joseph II's death. The consideration, respect and honours he enjoyed, and was to enjoy later, were not sufficient to counterbalance the bitterness he felt in seeing his University going through a dangerous crisis.

says? The fact is he was not dismissed. If one wants to give credit to Gattoni (he had peremptorily stated "That my pen might be directed by any passion is and will always be a calumny"), Volta's behaviour might be justified by the fact that he felt, as a public employee, he was dependent on constituted powers and was bound to be a disciplined subordinate. He uncritically bowed – though only outwardly – to those who commanded, "precise and punctual in obeying all impositions" (*VE*, III, p. 382). His biographers have always tried to justify his compliance with the orders and will of his superiors by underlining his common sense and attention to safeguarding his interests, to the point of thinking it legitimate to swear "Hatred to the Kings' government and allegiance to the Republic". Alternatively they refer to Volta's inclination to separate real political convictions from the mere formality of taking oath.

As we have already hinted, Volta finally went back to his chair of Experimental Physics in Pavia, not by decree of the Government of Vienna, as he had hoped to redress the wrong he had suffered, but rather by Napoleon's decree of June 1800.

Napoleon personally returned their chairs to the pro-Austrians Volta and Scarpa. About the latter Napoleon said: "What does it matter if he has refused to take the oath and if he has different political opinions? Doctor Scarpa honours the University and my States".

Volta accepted the appointment but only after a further attempt to be moved to the Grammar School at Brera.

The chairs and professors in Mathematics and Physics between 1796 and 1814 were:[54]

Subjects	Professors	Substitutes
General Physics	1796-99: C. Barletti, Piarist 1800-08: G.B. Venturi, priest 1808-14: A. Mozzoni	1796-99: N. Curioni, Augustinian 1799-1800: suspended 1800-01: C. Benferreri, friar 1801-02: suspended 1802-06: G.B. Savioli, Barnabite 1806-08: A. Mozzoni, Olivetan
Experimental Physics	1796-1803: A. Volta 1804-14: P. Configliachi	1802-03: S. Stratico 1803-04: P. Configliachi, Barnabite
Elementary Mathematics	1796-99: L. Mascheroni, priest 1800-03: M. Fontana, Barnabite 1803-09: G. Bellisomi	1797-99: A. Lotteri, Celestinian
Sublime Mathematics and Rational Mechanics	1796-1800: G. Fontana, Piarist 1801-14: V. Brunacci	1797-99: A. Lotteri
Applied Mathematics	1796-1800: M. Fontana L. Mascheroni (does not teach) G. Gratognini	
Introduction to Sublime Calculus	1803-14: A. Lotteri	
Hydrometry (from 1811: Hydrometry and Geodesy)	1802-14: V. Brunacci	
Civil and Military Architecture	 1807-14: G. Marchesi	1803: P. Pozzo 1804-07: G. Marchesi

After the journey to Paris in 1801, which was triumphal because of the flattering acknowledgments his work received by the main exponents of French science, Volta

[54] BEVILACQUA and FERRARESI (1991), pp. 199 and ff. See the paragraph *I docenti di matematica e fisica* (1796-1814), pp. 228, and following containing information on: new plans of study and discipline for the national Universities, the distribution of courses of Mathematics, Physics and Engineering, teachers-researchers and didactic methodologies).

took part, albeit reluctantly, in the meetings at Lyons as landowners' delegate from Como. He was not interested in the speeches in floods and "castles in the air" proposed and discussed there. Consistent with his common sense, he would have preferred, something more immediate and concretely advantageous.[55]

It seems he never actually spoke at the meetings, but the information is uncertain. He did speak sometimes, to defend religion (which, according to him, should not be discussed at all) and, anyway, to promote particular matters concerning his town. There is also no information on Volta's thought regarding the main questions under discussion, on the reactions provoked in him and in others, on his assents or dissents. Finally one gets the impression of substantial indifference to what was debated there, but perhaps he felt differently about balls and feasts.

After the triumphs of Paris in 1801 and the stay in Lyons where he fell seriously ill, his symptoms of tiredness, which had already made him leave the chair of Pavia in the past, grew worse. He got married late, when he was fifty; he had three young children who had to study (this is why he moved his family to Milan) and an extended family dependant on him. In his letters of that time, concern, attention and love for his family and his native country continuously emerge; in his mature years he was an exemplary father.

In 1803 he asked the Government for his "honorific superannuation" after almost thirty years of teaching; of course with its attendant severance pay! Configliachi succeeded him.

It is not clear when and where, from 1796 to 1804, Volta and his colleagues did their teaching. Nor is it clear with what order, continuity and efficacy they lectured in the clime of great confusion and uncertainty, amidst controversies, discussions, not to mention the long suppression of the University.

On the other hand, it is clear when and where, in that period, Volta did intense, advanced scientific work. His studies on the electrical properties of metallic chains headed discussion, at the end of the century when, with the University closed, he was dismissed from the chair without salary and retired to Como, where he concluded the invention of the pile.

Documentation on the subject of Volta's teaching is very poor.

Of his lessons the following have been kept: *Areologia* (Como, 1776), *Delle differenti specie di arie* (1783 and already dictated, in 1782, to Madame le Noir de Nanteuil), *Otto lezioni sulle proprietà dei gas e dei vapori* (manuscript of 111 pages kept by the *Classe des Sciences* of the *Institut de France*, concerning: permanent fluids, inflammable, mephitic, nitrous and dephlogisticated gases, vapours and phlogisticated air), *Saggio teorico e sperimentale di elettricità* (manuscript 1778-80), *Lezioni compendiose sulla Elettricità* (1784?) with the

[55] Also other colleagues from the University of Pavia took part in the Meetings: Brugnatelli, Moscati, Mangili, Ressi, Mattia Butturini (1752-1816) – a Hellenist – and Costanzo Gianorini (1745-1803) of Logic and Metaphysics.

inclusion of a letter to Madame le Noir de Nanteuil translated into French. The diaries of Giuseppe Mangili (1767-1829) contain extensive information on many experimental aspects of Volta's lectures.

The didactic reference book showed Volta's preference for the physics treatise of Johann Christian Polycarp Erxleben (1744-1777) of Göttingen.

In the above considered letter-report of April 1788 Volta dwelt explicitly on the problem of textbooks for his course. Until then he had used the annotated fourth edition (1774) of Musschenbroek's *Elementa Physicae conscripta in usus Academicos*. He judged that the majority of the most recent physics courses were "respectable ... but narrow and lacking many new things". He indicated two exceptions: Jean Hendrik van Swinden's (1746-1823) *Positiones Physicae, quas annuo labore in Scholis privatis explicat, experimentis illustrat etc.* and Erxleben's *Anfangsgründe der Naturlehre etc*. He expressed great approval for the latter, in the recent updated edition by Georg Christoph Lichtenberg (1742-1799), and proposed to translate it into Italian.[56]

The Government coldly pointed out that "the light of the Century and the University decorum" required that the two physics professors (Volta and Barletti) must commit themselves to write their textbooks.[57] They never did it.

The Emperor Napoleon, on a visit to Pavia in May 1805 when he was crowned King of Italy in Milan, complained that he had not met him in his post as a teacher. The following June Napoleon met Volta in Bologna, where the *Istituto Nazionale* was convened, and manifested his disappointment at not having found him teaching in Pavia.

Paul Janet (1863-1937), mentioning Volta's figure and work, reports that Napoleon had previously stated:

> Je ne saurais consentir à la retraite de Volta. Si ses fonctions de professeur le fatiguent, il faut les réduire. Qu'il n'ait, si l'on veut, qu'une leçon à faire par an; mais l'Université de Pavie serait frappée au coeur le jour ou je permettrais qu'un nom aussi illustre disparût de la liste de ses membres; d'ailleurs, ajoutait-il, un bon général doit mourir au champ d'honneur.[58]

The consequence was Volta's return to Pavia, though only for some months a year.

A few years later (1809), Volta was appointed Senator and the following year Earl of the Italic Kingdom.

Volta, thanking the Rector of the University who congratulated him for his "luminous office", replied with his natural modesty: "... I prefer this [job as a public teacher] to any others, and above all to political and economic ones, for which I have never had either inclination or talent ...".

[56] *VE*, II, pp. 433-5.
[57] *VE*, III, p. 38.
[58] COMITATO PER LE ONORANZE AD ALESSANDRO VOLTA (1928), I, pp. 36-7.

He did not carry out any particular activity either at the Italic Senate or the Meetings of Lyons, and he never spoke.

In 1805 he was given the possibility of becoming a member of the Academy of St Petersburg. He was offered a salary and the chance of working, both much better than those offered him by the Italic Kingdom. Volta refused the offer in a letter testifying, in addition to his complete involvement in the society he had lived in, his deep family love as well as his attachment to his native country, to the University he had honoured and which honoured him.

Spurred on by the high consideration of the Government and by the Emperor's many – and also tangible – proofs of admiration and warm, human sympathy towards him, he devoted his years to his family, the University and Como. He always maintained, without deviation whatsoever, the supremacy of the values of science of which he had been and still was an authoritative exponent.

He had made fundamental contributions to European eighteenth-century science, though working in a scientific context of discouraging poverty. He had expressed his highest potentialities in experimentation, thanks also to the Austrian reforms which had underlined his great value. Together with eminent colleagues he had been able to exploit the intellectual energies and operating capacities of the University of Pavia, contributing to that prestige which it enjoyed in Europe in all the fields of knowledge between the eighteenth and the nineteenth centuries.

However, he did not succeed, in spite of his good intentions, in forming a school. Physics in Pavia – undoubtedly learned and up-to-date, like Italian Physics in general – was to be able neither to conform itself to that methodological evolution, which was to involve the main scientific circles of beyond the Alps in the early decades of the new century, nor to express international contributions.

1814 marked the end of the "nice Italic reign". Napoleon, the "supreme hero", "the incomparable hero of the century, the supreme protector of Sciences and Arts, the Great Emperor and Our King ..." so openly exalted by Volta, was defeated and the old dynasty took the throne again in France.[59]

[59] Volta supported the attempt of the viceroy Eugène de Beauharnais to be crowned King of Italy. He had appreciated the Reign for its conquests and achievements and for the modernity of its points of view. He had by then absorbed, though with due prudence, French mentality and behaviour. He was right because what had been expressed by the Italic Kingdom in its ten years of life, would have considerably affected the Italians' political maturity. No doubt, however, his conservative nature was important. It is not clear how and with what commitment he had supported Eugène's attempt. How did Volta live through the tumults of the spring of 1814? Was he or was he not present in the Hall of the Senate on April 17 and 20? According to some biographers he was, and "with common sense he pleaded the cause of Eugène"; according to others he was not because he had to stay at home due to a "sudden serious indisposition". It is certain that on the night of the 20th Volta left Milan and quickly but not easily reached Como where, for prudence, he stayed with some friends.

On April 28, 1814 the Austrians entered Milan and a great part of the Italic Kingdom became subject to their authority.

Magnanimously passing over his past French record, Vienna called Volta back to Pavia as Dean of the Faculty of Physics and Mathematics (1814) of that University "owing to the Austrian Kings its most beautiful establishment". He was by then almost seventy but he did not run away from the invitation to come back and make the glorious University famous with his mind. Besides, his children started their university studies in Pavia that year, and his common sense, together with his capacity to benefit from the most varied situations, made him think that his new office might help their studies.

He returned to be a subject of Vienna, a faithful, obedient and respectful subject. He exerted himself to keep the ancient and new family nobility and the honours received from Napoleon. Gattoni had already noticed that "there are some who are able to feel at ease in every corner of contradictory propositions".

Volta, though triumphantly closing the eighteenth century, entered the following century without well defined, prospective programmes of research. A few years after his invention of the pile, he almost completely abandoned experiments with it and limited his interests to the theoretical interpretation of the way it worked, almost completely ignoring its practical applications.

While all over Europe, in few years, new laws, relations and techniques opening up new and important areas of investigation were being found, Volta managed to anticipate, although only in qualitative terms, the correlation between tension and intensity of current in metal conductors. He also announced very late that he had decomposed some chemical substances and, through Configliachi, he made public (1814) one of his memoirs which underlined, without adding practically anything new, his old conceptions on the working of the pile.

Therefore, he was practically absent from the scientific debate following his invention which, as we have already pointed out, was bound to lead to the spread of electrochemistry and electrodynamics and, as a consequence, to the spread of electrotechnics and electromagnetism. These just represented the four sectors which were the most remarkable and fundamental fruit, either direct or indirect, of the invention of the pile.

He did not give much importance to all the phenomena which accompanied electric currents and he did not devote himself to their qualitative or quantitative aspects. In so doing, he missed important consequences which nobody else at that time had so nearly within reach. He was neither able to appreciate the importance of his discovery nor to foresee its applications and developments. Yet he was at the height of his intellectual maturity.

The lack of solid mathematical bases no doubt was a serious curb to his whole work; even more so at the beginning of the nineteenth century, when new methodological conceptions established themselves through mathematisation for physical science.

He had always been working on his own and with little help from others and he did not form a school capable of continuing his work He rather left a difficult legacy

which, no longer fostered by strong personalities, was bound to fade in a few decades, especially from the theoretical point of view.[60]

The fact that he did not manage to form a school is undoubtedly a weak aspect of his commitment as a teacher. Indeed, during his travels abroad and especially in France, Volta had noticed different approaches to science, far from the typically eighteenth-century amateurish spirit which, consciously or unconsciously, had led his activities till then. He recognized the need to professionalise scientific work by means of a school, involving the State more, also at a financial level.

On a few occasions, before and after the French returned to Lombardy (1800), he addressed himself to the Government explaining the necessity of preparing new study plans.

In both cases, he reveals his desire to give up spectacular teaching – since it was accompanied by "experiments of amusement" – addressed to the large and heterogeneous audience which used to crowd his lessons, in order to devote himself to training disciples in the areas of research he was interested in. (His usual audience numbered about two hundred and was made up of "varied humanity": physicists, students, amateurs but often by circus artists seeking ideas for their work with electrical effects).

He suggested radical reorganisation of Physics teaching which he rightly considered insufficient. At the same time he proposed measures aimed at improving the professionalisation of research, claimed the need for a laboratory supported by the State to create a new figure, the physicist; in other terms, a true school for physicists. The qualitative leap he proposed was relevant and it would certainly have helped him enter the scientific debate of the early decades of the new century.

Nevertheless, as already hinted, they were difficult decades from the financial point of view.

Besides all this, after the triumphs of Paris and the misfortune which befell him in Lyons, Volta sensibly diminished his didactic and scientific commitment leaving his charges to supply teachers of modest stature. Besides, his wish to get closer to his family in order to take care of his children's education was increasing.

Therefore, his two proposals were made at an unlucky moment.

Finally, another suggestion was illustrated by Volta in a note of the second half of 1802. It was to be the last document sent directly from him to the Government, even though he continued to keep personal, epistolary relationships with various politicians.

The Government however replied (November 4 of the same year) rejecting his proposals.

[60] Francesco Mocchetti (1766-1839), Raffaello Tosoni (1779-?), Stefano Marianini (1790-1866) and Giuseppe Baronio (1758-1811) may be considered disciples of his, at least to a certain extent. But they were generally people of modest stature and scientifically insignificant. Only Marianini reached some fame.

Coming back to the problem with a letter to the Minister of the Interior (November 15), after stressing the spirit of his proposal and declaring his availability to hold a course of Experimental Physics in Pavia for a couple of months, in spring and summer, Volta did not hide his regret for the Government's little consideration regarding his proposals and replied in a pleasantly polemical tone.

He concluded his letter asking for the "honorific superannuation" at two thirds or possibly the whole of his salary.

The Minister of the Interior accepted Volta's resignation (March 1803) at two thirds of his salary. However, at Volta's request (May 1803) and considering his improved health, the Minister of the Interior coldly agreed to suspend the resignation and apply it from the new academic year to his chair of Experimental Physics at the University of Pavia.

Finally, in a letter of 1803 without a precise date nor indication of the addressee, after mentioning the keen studies and research on galvanism carried out in France and Germany by physicists, chemists and physiologists with applications in the therapeutic field, Volta polemically denounced the Government's inertia, as usual mingling personal complaints with more general propositions.

So Volta was looking for the State's moral and financial support to create a school. He was ready to give up the large, heterogeneous audience who used to attend his lectures, exciting his satisfaction and enthusiasm and the envy and resentment of many colleagues. He understood that only by means of public resources granted by a caring State and by gathering around him young people interested in studying Physics could scientific progress be assured in a professional dimension.

The decline in Volta's scientific commitment, till his almost complete absence from the international scene in the first few decades of the nineteenth century, is probably due, besides health and family reasons, to the Government's lack of commitment to his proposals, which no doubt caused his disappointment and bitterness. Napoleon's subsequent personal encouragement did not change much. Volta was bound to remain the undisputed exponent of a typically eighteenth-century way of creating science by then surpassed by those new methodological concepts which, through mathematisation, were to characterise the new century. He was aware of his deficiencies and limits.

He had not been able to enter the new century but he remained in any case *in re electrica princeps*, for it is indisputable that, in spite of his limits and deficiencies, his very acute sense of Physics, his incomparable qualities as an experimenter, as well as his extraordinary fruitfulness, had led him, amid truth and errors, to make fundamental contributions to the quantitative development of electrostatics and to the autonomous development of electrology (and not only electrology) and to mark a fundamental stage in the History of Science in general. It is therefore correct to consider Volta as one of the greatest interpreters, if not the greatest, of eighteenth-century science. However a school would no doubt have helped him enter the new century.

There are no documents which betray his aspiration to national independence, freedom and democratic regulation of a united Italy. Nevertheless these concepts

were gaining more and more ground in Italian public opinion at that time, as an introduction to national salvation. The ideals and torments brought about by the new times were not voiced by him in any way; his "native land" still remained his darling Como and its environs.

In 1814 Volta lost Flaminio, his most promising son, in whom he had placed great hopes. This was a great blow to him and seriously affected his soul as well as his physique.

Humphry Davy (1778-1829), who happened to approach him after the misfortune, describes him as "an old man, undermined in his health, whose conversation was not brilliant". He noticed in him the simple manners which had characterized him all his life but, at the same time, he found him tired and dull as if life did not interest him any more, he found him a stranger "no longer familiar with the world".

In 1819, after his two sons had got their degree in law, he retired spending his days between Como and Camnago; he definitely left the scene.

The University of Pavia had seen him among its greatest exponents for about thirty years and more occasionally for the following fifteen years. It owed much of its fame and fortune to him. It carried on its creative function of knowledge, in spite of its slow decline due to Vienna's disengagement and to the lack of prospects in society, which was becoming more and more restless and, above all, longed for freedom and independence. In a few decades it was to sink from European heights to lower levels. Though it kept its dignity, it fell into line with the other Italian Universities who had not known that splendour which for almost a century had distinguished the University of Pavia.

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